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Revision of the  
balanomorph barnacles;  
including a catalog  
of the species

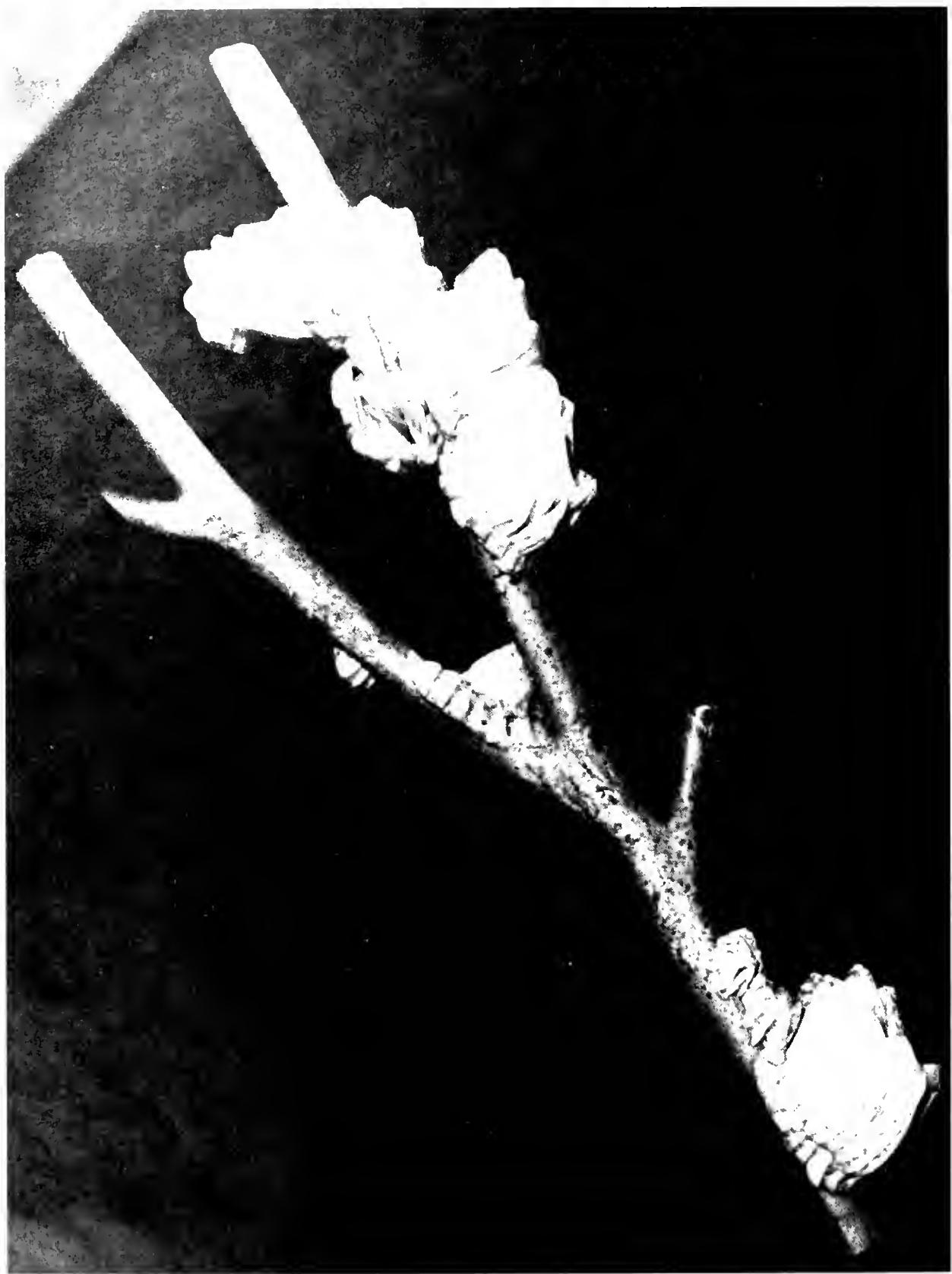
William A. Newman  
and Arnold Ross

MEMOIR 9

*San Diego Society of Natural History*  
1976







**Revision of the  
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**William A. Newman  
and Arnold Ross**

**Scripps Institution  
of Oceanography  
and San Diego  
Natural History Museum**

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Frontispiece. *Chionelasmus darwini* (Pilsbry)\*, one of the most generalized or primitive living balanomorphans, is known from two isolated insular situations where it inhabits relatively deep water (approx. 450m). The first specimens were taken near the turn of the century by the U. S. Fisheries Steamer *Albatross* off Kauai Island, Hawaii, and then a couple of decades later by a cable ship off Rodriguez Island, southwestern Indian Ocean. While additional specimens have been taken near the original localities, there are no reports of any having been found between these two extremes. *Chionelasmus* therefore qualifies as a refugial form, but not a usual one since it is both insular and in relatively deep water, well out of the mainstream of balanomorph evolution.

\*(R/V Te Vega Sta. 23-95, Sept. 4, 1971, S. of Molokai I., Hawaii — specimens courtesy of Dr. D. P. Abbott, Hopkins Marine Station, Stanford University.)

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## INTRODUCTION

The Cirripedia constitutes a diverse and abundant subclass of crustaceans, and representatives are found in virtually all marine environments. There are four orders, the Ascothoracica, Rhizocephala, Acrothoracica and Thoracica. The Thoracica contains the true barnacles and these are distributed between three living suborders; the stalked barnacles or Lepadomorpha, the asymmetrical sessile barnacles or Verrucomorpha, and the sessile acorn barnacles or Balanomorpha. These appear in the Silurian, the middle Cretaceous, and the late Cretaceous, respectively. The Balanomorpha encompasses the greatest diversity of free-living and symbiotic forms, and as Darwin (1851a:5) noted, the present epoch may go down in the fossil record as the "Age of Barnacles" (Fig. 17).

The basic classification of the Thoracica was formulated by Darwin (1854b), and his system was expanded and somewhat revised by Pilsbry (1907a;1916). Pilsbry's classification formed the basis for that in the *Treatise on Invertebrate Paleontology* (Newman et al, 1969). Although the *Treatise* provides diagnoses of taxa to the generic level, it does not enumerate the species contained in each genus, nor does it provide a guide to the literature concerning them. The present study fills these needs for the Balanomorpha. It also constitutes the first major revision of higher taxa in more than half a century.

The Balanomorpha may not be an entirely natural assemblage, but rather a grouping of phylogenetically parallel lineages not readily derivable from one another nor from a common balanomorph ancestor. The possibility of at least a diphyletic origin was suggested by Withers (1924:2). Thus, in preparing this revision we were alert to the possibility that the Balanomorpha might be separable into two or three suborders. However, in the final analysis it became clear that such a proposal was indefensible or premature. Therefore, the Balanomorpha in the broad sense has been retained. Yet three major lineages can be recognized, and we consider them to constitute superfamilies: Chthamaloidea, Balanomorphoidea and Balanoidea. In addition, one new family and numerous subfamilies are also proposed here, and many of the 65 genera contained in the Balanomorpha are redistributed within this modified systematic framework (Fig. 1).

Much of what has been done here might be interpreted by the casual observer as simply "splitting" and "rank-raising." Indeed, Hyman

(1959:697) voiced concern over systematic practices in recent years: "Any acute observer cannot fail to notice the disease prevalent in zoological systematics today of raising rank of groups and of assigning high ranks to groups that differ only in minor characters." Nevertheless, in the present study new lines of evidence indicate previously unrecognized affinities, and it seems to us that the classification must be altered and expanded to accommodate them.

Initially, classification of thoracicans depended on surficial morphology of the shell, and it is only in recent years that thin sections have revealed remarkable internal structures that have drastically altered our understanding of the affinities among the Balanomorpha. Likewise, comparative studies of trophi and chaetotaxis, or of such structures as the base of the intromittant organ, have greatly improved and broadened our understanding of interrelationships between higher and lower taxa. In addition, numerous collections by both individuals and expeditions, from the deep sea, from coastal waters, and especially from tropical seas where the greatest diversity is found, have provided new materials that have compelled us to alter our concepts and rearrange existing groupings in order to continue to develop a natural system. If our system is accepted, the practical inconvenience and annoyance will really be quite temporary.

## HOW TO USE THIS WORK

The specialist will probably have little difficulty in using this work, but some explanations seem appropriate. It is divided into three parts: evolution, systematics and catalog of species. We have attempted to arrange the genera and higher taxa phylogenetically. However, for simplicity, ease, and (or) lack of knowledge, species are listed alphabetically under their respective genera or species groups in the catalog. The index is the entree to species. The first page number given after each species leads to that species in the catalog. For genera and higher categories, and for some species, the index leads into the systematic and evolutionary sections as well. Species names in the index are given without generic indication unless they have been used in more than one genus. In such cases the generic names used in this work are given.

Diagnoses of suprageneric taxa, and for a single new genus (*Notobalanus*), are provided in the systematic section. Diagnoses for established genera can be found in the *Treatise on Invertebrate Paleontology* (1969); original sources for subsequently described genera are cited herein.

The general arrangement of the catalog follows that of the preceding evolutionary and systematic sections. The original author, date and page are cited for each species and, where appropriate, a citation of the most comprehensive synonymy, which may not necessarily be the most recent. This is followed by a relatively complete list of references through 1973, but including many through 1975; many of the non-systematic papers are briefly annotated. Finally, general distributional and sometimes bathymetric and stratigraphic data are included, but needless to say, distribution of the majority of the species is very poorly known. Following the body of the catalog there is a list of species *incertae sedis*.

## ACKNOWLEDGMENTS

The primary data base for this work was, quite naturally, the literature, and we have cited virtually all that was available to us. Much of the contemporary literature was made available as reprints by authors and others, and we thank them for their generosity. A large portion, however, came from various university and museum libraries, over many years, through direct borrowing and interlibrary loans. Librarians involved are too numerous to mention individually, but we thank them, known and unknown to us, for their services.

As with many data bases, sources extend well beyond published works, and we are much indebted to numerous cirripedologists for voluminous oral and written communications. There have been so many we hesitate to mention them by name, for fear of not including all. But we must acknowledge Huzio Utinomi of the Seto Marine Biological Laboratory; Alan J. Southward of The Laboratory, Plymouth; Elizabeth C. Pope of the Australian Museum; and Victor A. Zullo, University of North Carolina at Wilmington.

Data were also extracted from the vast collections of the Scripps Institution of Oceanography and the San Diego Natural History Museum, and from materials made available on loan by curators of collections in other institutions. In particular, we would like to thank Thomas E. Bowman of the National Museum

of Natural History; Torben Wolff of the Zoological Museum, Copenhagen; Jan Stock of the Zoological Museum, Amsterdam; L. B. Holthuis of the Rijkmuseum, Leiden; J. P. Harding of the British Museum (Natural History); William K. Emerson of the American Museum of Natural History; and J. Wyatt Durham of the Paleontology Department, University of California, Berkeley. We have also garnered knowledge and experience from innumerable specimens sent to our laboratories for identification by ecologists from all over the world.

Development of the catalog has passed through the hands of several assistants. It began many years ago as a compilation of references to species of immediate interest in contemporary literature, and was subsequently expanded to include all primary literature on all species by Mrs. Carol Platt-Kourtz, who carried it forward for five years as a sideline to her regular work. Mrs. Cecelia Ross spent nearly a year of intensive work on it, and finally Ms. Gayle Kidder aided substantially in bringing it to its present state. We thank these young ladies for their concerted efforts and ask their forgiveness for the moments when attention to detail became excessively tedious.

This revision is for the most part a by-product of our work on the systematics of the Cirripedia. Support, in part, was provided by several grants from the National Science Foundation (to W.A.N.: GB-4973X through BMS575-17149), and these are gratefully acknowledged.

## HISTORICAL

Classification of the thoracican Cirripedia, beginning in good part with the work of Leach (1817, 1818, 1825) and Gray (1825), was placed on a firm foundation by Darwin (1851-1854). Darwin's three basic divisions, the Lepadidae, Verrucidae and Balanidae, are the principal ones recognized today (Pilsbry, 1907a, 1916; Krüger, 1940; Withers, 1953; Newman et al., 1969). Progress in the classification of the Thoracica, from Leach (1817-1825) to that being proposed, is given in Figure 1. Gruvel's (1903b) classification is omitted. Suprageneric taxa are indicated only under the Balanomorpha.

The Lepadomorpha (= Lepadidae *sensu* Darwin) contains the most primitive Thoracica, members of which are inferred to have arisen from a free-living stem near the Ascothoracica (see Newman et al., 1969; Newman, 1974:437). While the unity of the Lepadomorpha has never been questioned, the relationships of the scalpell-

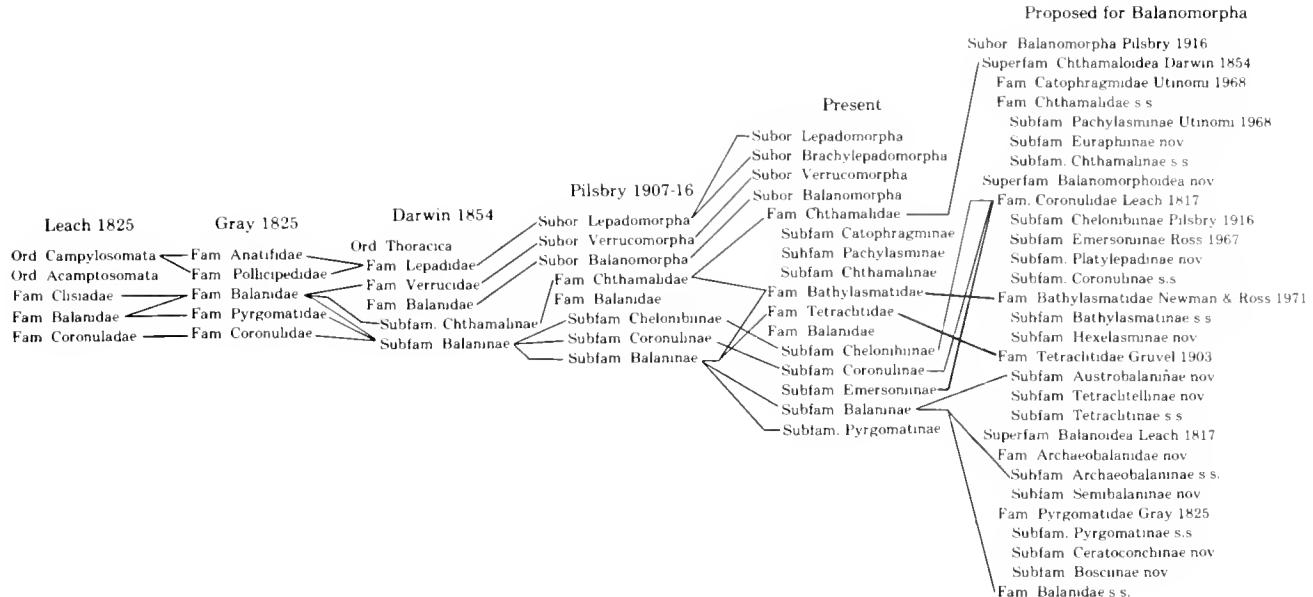


Figure 1. History of the classification leading to that proposed for the Balanomorpha.

form and lepadiform groups remain obscure. However, problems that arise in this regard have no direct bearing when considering the origins of the Balanomorpha, because it is generally agreed that one looks to the scalpelliform or pollicipoid barnacles for the antecedents of the sessile barnacles (Darwin, 1854b; Withers, 1953; Broch, 1924; Newman et al., 1969; Newman and Ross, 1971).

Darwin's (1854b) classification of the Thoracica reflects the view that the sessile barnacles (Verrucidae and Balanidae) evolved from the Lepadomorpha as independent lineages. The Verrucomorpha was recognized by Darwin (1854b:495) as sharing a number of characteristics with the Lepadomorpha and the Chthamalidae among the Balanomorpha. However, the sum of the characters he enumerated favor a lepadomorph rather than a balanomorph ancestry for them. Withers (1914:945) considered *Proverruca* from the upper Cretaceous to "constitute, in fact, the 'missing link' between the pedunculate Cirripedes of the family Pollicipedidae [= Scalpellidae] and the sessile asymmetrical Cirripedes of the family Verrucidae." The two lateral plates of one side seen in *Proverruca*, and *Eoverruca* but missing in *Verruca*, are homologous with those of the presumed ancestor of the Balanomorpha as well as the Verrucomorpha. Thus, what these early verrucids indicate is that the lepadomorph ancestors of both suborders were comparable (Fig. 2).

The next sessile suborder, the extinct Brachylepadomorpha, was unknown to Darwin. It was instituted by Withers (1923:37) to ac-

commodate *Brachylepas*, which Woodward (1901: 150) previously considered a pedunculate barnacle. Withers (1953) subsequently discovered that *Pycnolepas* Withers (1914) was not only a sessile barnacle, but also that it was intermediate in structure between stalked barnacles and *Brachylepas* (Fig. 2). He stated that, while the Brachylepadomorpha "includes the commonest and most widespread of the Cretaceous symmetrical sessile cirripedes. . . ." they "do not appear to be in the direct line of descent of the Balanomorpha, as already pointed out by Pilsbry. They apparently represent an independently developed sessile type, which, except for the reduced number of capitular valves, probably resembled the ancestor of the Recent primitive Balanomorpha (*Catophragmus*)" (Withers, 1953:344; see Fig. 2).

Gruvel's (1903b) classification of the Balanomorpha departed radically from Darwin's scheme, but it was rejected by Pilsbry (1907a, 1916) and subsequent workers as in good part unnatural. Pilsbry (1907a, 1916) elevated Darwin's families to suborders, primarily to allow for an expanded classification at subfamilial levels. Darwin's Balanidae thus became the Balanomorpha, containing two families, the Chthamalidae and Balanidae. He further divided the Balanidae into the Balaninae, Chelonibiinae, and Coronulinae, all primarily on the basis of shell characters.

Numerous subgenera, in good part based on characters Darwin (1854b) used in formulating sections, have been proposed, particularly by Pilsbry (1916) and Hoek (1907), especially

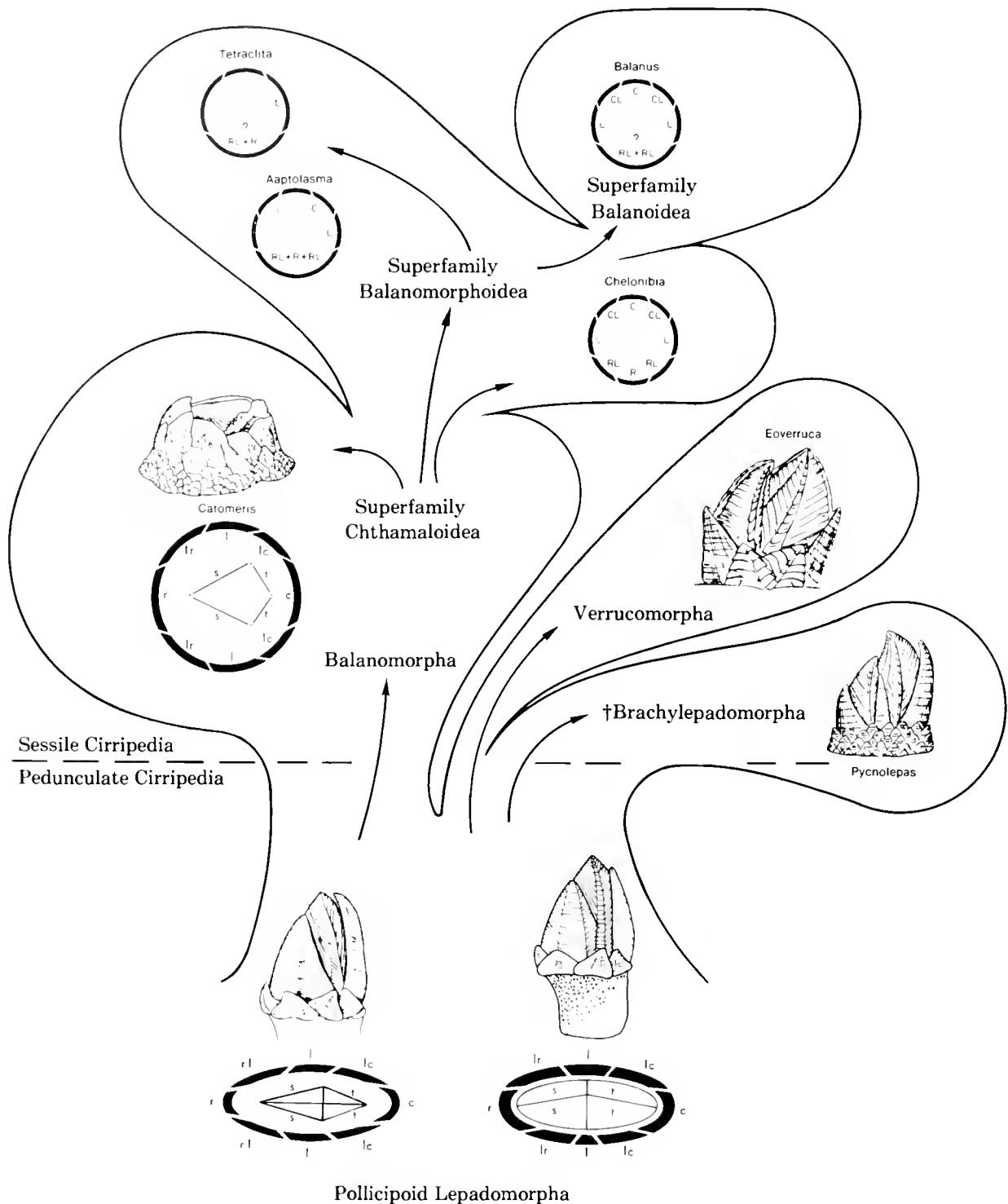


Figure 2. Monophyletic origin of the Balanomorpha and inferred relationships: The principal divisions (superfamilies) of the Balanomorpha are directly related to and stem from a pedunculate stock allied but distinct from that which gave rise to the Verrucomorpha and Brachylepadomorpha. Radiations and relationships of the superfamilies are illustrated in figures 4, 5 and 6. (see text for discussion.)

in the Balaninae. Yet, in the years since Pilsbry (1916), few alterations have been made in the basic classification of the Balanomorpha. Nilsson-Cantell (1921) resurrected Gruvel's (1903b) Tetraclitinae (in part) as a subfamily of the Balanidae, and fostered the Stellatus- and Hembeli-groups of *Chthamalus*, suggested by Pilsbry (1916). Ross (1968) subsequently elevated the Tetraclitinae to familial level; Utinomi (1968) divided the Chthamalidae into three subfamilies; Ross (in Ross and Newman, 1967) created the subfamily Emersoniinae for an extinct form allied to the turtle barnacles; Newman and Ross (1971) proposed the family Bathylasmatidae for a group of relatively primitive deep water balanoids; and Ross and Newman (1973) resurrected Gray's (1825) Pyrgomatidae (in part), a name available for a group of coral barnacles designated Creusiinae by Baluk and Radwánski (1967b: 468). Despite these advances the broad aspects of the classification have remained the same. As it stands, it fails to portray many actual or inferential relationships and this has necessitated the present revision.

Although application of the biological species concept spread in systematic studies of other groups, the Darwinian tradition of numerous varieties (subspecies) in the cirripeds has continued to prevail, especially in the Stellatus-group of *Chthamalus*, *Tetractita* s.s., the *Balanus amphitrite* group, the subgenus *Megabalanus*, and the coral barnacles.

Students of the balanomorphs will find some unfamiliar features in what we propose and these may be quite disconcerting without background information. Darwin's work on the Cirripedia had a profound two-fold effect. On one hand, he established the basic classification and brought order to a chaotic and wide spread literature. On the other hand, he arranged the higher taxa in such a manner as to bias virtually all subsequent phylogenetic studies. While Hoek (1913) and Pilsbry (1916) expanded

upon the basic framework, they retained the Darwinian order in their monographs in which the morphologically primitive forms, the chthamalids and coronulinids, appeared at the end and the more highly evolved forms such as *Megabalanus*, appeared at the beginning. The first break in tradition came with Gruvel (1905a), and in a more acceptable manner, with the work of Nilsson-Cantell (1921), Krüger (1940), and Withers (1953), where the various groups were, with the exception of the turtle and whale barnacles, placed in a more or less acceptable phylogenetic sequence.

The present study is a further attempt to order the balanomorphs as naturally as possible, down to and including the subgeneric level. In doing so, some marked departures from previous classifications have been made. This may not prove upsetting to new students of the Balanomorpha, but the "old line" may find it difficult to accept the turtle and whale barnacles as groups having relatively primitive origins, and to find the tetraclitids closer to them than to the balanids.

It may also prove disconcerting to find that most free-living acorn barnacles cannot be readily assigned to either *Chthamalus*, *Balanus* or *Tetractita*. But it must likewise have been upsetting to earlier students of the group when certain workers decided that most barnacles were not *Lepas* as Linneaus had established. The changes proposed herein reflect a sharpening of resolving power over the past decade or so, a sharpening made possible through the efforts of many students of this remarkable and fascinating group of animals.

Beginning on page 25 we illustrate various features and relationships of the shells and appendages of the balanomorphs. These were originally prepared to aid us in our understanding of the diversity of morphologies involved, and it is hoped that they will be useful to the reader.

## ORIGIN OF THE BALANOMORPHA

### MONOPHYLETIC

Until recently the Balanomorpha consisted of the Balanidae and Chthamalidae. Darwin (1854a:152, 176) and subsequent authors, considered the Chthamalidae the more primitive and directly derivable from scalpelliform barnacles. The criteria for this judgment cover both homologies of hard parts and morphology of appendages, especially in the most primitive or generalized chthamalid, *Catophragmus* (*Catomerus*). The fossil record supports this interpretation, because *Catophragmus* appears in the late Cretaceous. Representatives of the Balanidae do not appear until the early Eocene.

In the chthamalid *Pachylasma*, while the body and appendages are wholly chthamaloid, the shell wall and to some extent the operculum are in certain respects balanoid in appearance. Darwin (1854b:475) stated that when he first examined the shell of *Pachylasma* he "did not doubt that it was . . . *Balanus*." But when he examined the animal's body, he found the characteristics preeminently chthamaloid, and concluded that (1854b:477) "*Pachylasma* would be the point of contact [of the Chthamalidae] with the Balaninae, . . . [for] when the shell alone . . . is examined, it is hardly possible to separate this genus [*Pachylasma*] from *Balanus*." Unfortunately, the fossil record does not lend support to this view because *Pachylasma* first appears in the Miocene, well after the appearance of *Balanus*. Nonetheless, the implication exists; the Balanidae may have come from the Chthamalidae via *Pachylasma*.

Subsequent work on the origin of the Balanidae seemed to make a chthamalid ancestry more plausible. Hoek (1883, 1913) described a number of deep-water species that appeared by shell characters to belong to *Balanus*, but the nature of the soft parts, particularly the structure of the labrum and the third cirrus, was atypical, and while he considered them balanids, he proposed the genus *Hexelasma* for them. Pilsbry (1916) reviewed the status of this genus and concluded that the species in *Hexelasma* belonged instead to the Chthamalidae, close to *Pachylasma*, and this assignment was followed by Krüger (1940), Withers (1953), Zullo (1963a), and Utinomi (1968). Zullo (1963c:190) oversimplified this picture with his sweeping statement that "the Balanidae . . . differ materially from the *Pachylasma* group [including *Hexelasma*] only in the structure of the labrum . . . and

that they were derived from the *Pachylasma* group stock." Despite this oversimplification it would seem at this point that there would be relatively little difficulty in deriving balanids from chthamalids, for the shell of *Pachylasma* and soft parts of *Hexelasma* would appear, superficially, to bridge the gap.

Taking this simplistic view at face value, a model for a monophyletic diversification of the Balanomorpha would be as follows (Fig. 2). The Chthamalidae, containing the most primitive members of the suborder, gave rise to the remainder of the Balanomorpha. Fundamentally, chthamalid hard parts consist of deeply articulated opercular valves, a wall of eight solid plates (three pairs of laterals overlapping the unpaired carina and rostrum), and several whorls of small imbricate plates, comparable to the peduncular plates of certain scalpellids, surround the region where the wall contacts the substratum. The basis is membranous. A large bullate, lepadomorphan-like labrum surrounding the mouth parts has mandibular palps situated on its lateral margins. The scalpellid-like mandible, composed of several incisor-like teeth and a spinous rather than molariform inferior angle, is simple. The first and second cirri are modified to assist in the transfer of food captured by the posterior four pairs to the mouth parts; that is they have been modified to serve as maxillipeds. The cirri, armed with simple setae and lacking specialized spines are like those of the Lepadomorpha. The penis, originating between the last pair of cirri below the anus and flanked by a pair of multiarticulate caudal rami or appendages (the furca), lacks a basidorsal point. All these features are found in the most generalized members of the extant Chthamaloidea, *Catophragmus sensu lato*, fossil forms of which are the oldest balanomorphs known (late Cretaceous).

Diversification of the chthamalids included the appearance of a number of lineages in all of which the whorls of imbricate plates were lost, the number of wall plates was reduced from eight to six, and in some cases four, and the caudal appendages inevitably disappeared (Fig. 4). The reduction of wall plates from eight to six was accomplished in two different ways — most commonly the carinolaterals drop out, thereby retaining the arrangement where the rostrum as well as the carina remain overlapped; and less commonly, the rostrolaterals fuse with the rostrum forming a compound plate that overlaps the adjacent laterals. The latter

arrangement is the same as that seen in higher non-chthamalid Balanomorpha and is presumed to herald them. The chthamalid bullate labrum, inherited from the Lepadomorpha, gave way to the thick but non-bullate condition, with concomitant changes in the nature of the mandibles to the more advanced balanid type. The third cirri became intermediate in structure between the second and fourth rather than more closely resembling the fourth, and the opercular valves became complexly but not deeply articulated; all features seen in *Hexelasma* and related genera (Bathylasmatidae).

Further advances included a flattened labrum that became cleft, aiding in the removal of food from the cirri. Concomitant with this, the third pair of cirri completed the transformation to maxillipeds. Apparently at this point the solid-walled Balanidae and Tetraclitidae appeared and diverged from the ancestral Bathylasmatidae (Figs. 2, 4 and 5). Both went on to develop distinctly different complex wall types, variously armed cirri, and in the balanids, a penis with a basidorsal point.

## POLYPHYLETIC

As palatable as the monophyletic scheme may be, Zullo (1963c:190) noted that there were conflicting views regarding affinities within the Balanomorpha and that it is possible that the balanomorphs are polyphyletic. Withers (1924:2) stated that he was "not at all convinced that the Chthamalidae and Balanidae . . . are so nearly related as is supposed," but he did not pursue the subject in subsequent writings (through 1953). Recently, Utinomi (1968:33), expressed a similar view, suggesting that the two families were independently derived from lepadomorph ancestors, but unfortunately he did not elaborate further on the matter. We became involved in the problem of the unity of the Balanomorpha when working on a revision of *Hexelasma* (Newman and Ross, 1971). In this regard, Bage (1938:10) had already pointed out that, "from the examination of the soft parts of the animal it is apparent that the reference of the genus [*Hexelasma*] to the Balanidae or

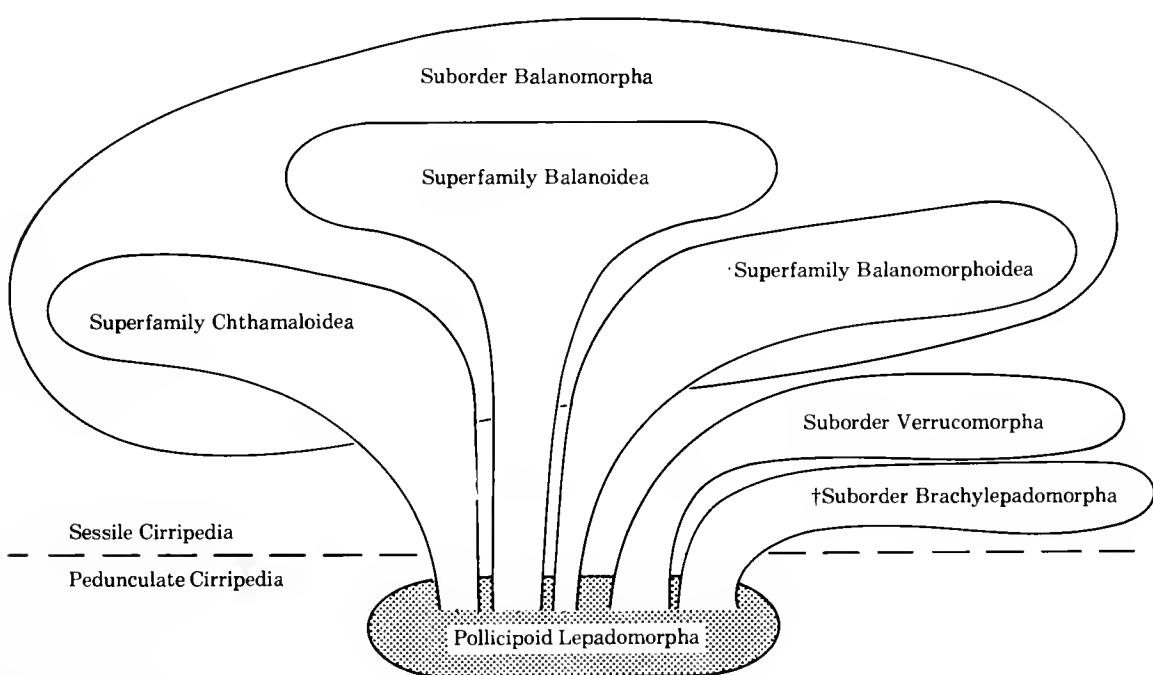


Figure 3. Polyphyletic origin of sessile cirripeds: It is well documented that extinct Brachylepadomorpha and the Verrucosomorpha (Jurassic to middle Miocene, and middle Cretaceous to Holocene, respectively) evolved from pedunculate ancestors before the appearance of the Balanomorpha (Cretaceous to Holocene). The Balanomorpha also descended from pedunculates rather than from earlier sessile groups (see fig. 2 for fundamental structural differences). Thus, sessility evolved three times. However, there have been suggestions in the literature that two or more of the principal divisions of the Balanomorpha also may have had separate pedunculate ancestors, as illustrated here. If this were so, sessility within the Thoracica would have evolved four or five times (see text for discussion).

Chthamalidae, discussed by Hoek (1913) and Pilsbry (1916), remains unsettled." In our study (Newman and Ross, 1971:143) it became clear that *Hexelasma* and its allies stand distinctly apart from the chthamaloids and balanoids and that it was impossible to supply facts supporting the long standing view that it is from the chthamaloids, through *Pachylasma* and *Hexelasma*, that the balanoid barnacles have descended. Therefore, we instituted the Bathylasmatidae, to accommodate several genera, including *Hexelasma*, because the group could not be properly assigned to either the Chthamalidae or the Balanidae, and suggested that antecedents of the bathylasmatids may well be found among the scalpellid Lepadomorpha rather than the Balanomorpha.

However, in the foregoing, the balanoid rather than chthamaloid affinities of the Bathylasmatidae were emphasized, and while the Tetraclitidae was recognized as a distinct family, it was placed rather closer to the Balanidae than the Chthamalidae, with the "elminoids" standing in a somewhat intermediate and questionable position (Newman and Ross, 1971:143). Ross (1970:9) provided the solution to the last problem by demonstrating that at least two species referred to *Elminius* by previous authors were in fact tetraclitids rather than balanids. Hence the difficulties posed by the elminoids

evaporated and the four families of the Balanomorpha became more sharply defined.

The gulf between chthamaloids and balanoids is particularly great. The tetraclitids and bathylasmatids are envisaged here as more closely related to one another than to either the chthamaloids or the balanoids. Although the tetraclitids and bathylasmatids are separable, there is presently no reason to believe that the former have not evolved from the latter, and it is to this complex rather than the balanoids that we infer the coronulines and chelonibiines are most closely related. Thus, it remains possible that the Balanomorpha is triphyletic; an artificial assemblage of three independently evolved sessile types (Fig. 3). If this were the case, sessility was achieved five times in the Thoracica: once in the Verrucosomorpha, once in the Brachylepadomorpha, and three times in the Balanomorpha — all from comparable, but lepadomorph ancestors. Nonetheless, for the aforementioned reasons, the Balanomorpha is retained here, even though it may not be a natural grouping. As a partial solution to this problem we propose that the families recognized here be distributed between three superfamilies, the Chthamaloidea, the Balanomorphaeidea, and the Balanoidea. Should polyphyly be documented in the future, one or more of these would of necessity become suborders.

## EVOLUTION AND DIVERSIFICATION

### CHTHAMALOIDEA

Darwin (1854b:486) commented that ". . . *Catophragmus* forms, in a very remarkable manner, the transitional link [between the Chthamalidae and the Lepadidae], for it is impossible not to be struck with the resemblance of its shell with the capitulum of *Pollicipes*. In *Pollicipes*, at least in certain species, the scuta and terga are articulated together — the carina, rostrum, and three pairs of latera, making altogether eight inner valves, are considerably larger than those in the outer whorls — the arrangement of the latter, their manner of growth and union, — all are as in *Catophragmus*. If we, in imagination, unite some of the characters found in the different species of *Pollicipes*, and then make the peduncle so short (and it sometimes is very short in *P. mitella*) that the valves of the capitulum should touch the surface of attachment, it would be impossible to point out a single *external* character by which the two genera . . . could be distinguished." As Withers (1928b) noted, Pilsbry (1916) suggested an even nearer likeness with the more specialized *Scillaelepas*, and this model was adopted by Newman et al (1969:R269, fig. 90).

Darwin further noted that the trophi of chthamaloids are similar to those of lepadomorphs. The labrum is thick and bullate, and this is basically a lepadomorphan character. The tridentoid mandibles and the multiarticulate caudal appendages of the primitive chthamaloids are typical of the pollicipoid lepadomorphans, and it is the sum of these arthropodal structures that separate the chthamaloids from other Balanomorpha. The first and second cirri are modified for cleaning the posterior net-forming pairs of particulate matter and transferring it to the mouth. In lepadomorphs, generally but one pair of cirri is so modified, but pollicipoids have modifications of the second and even the third pairs (Darwin, 1851b:313). Finally, the base of the penis is simple, without basidorsal point, as in all thoracicans except the Balanoidea. In general, the trophi and chaetotaxis are most conservative throughout the lower chthamaloids and readily distinguish the entire stock from the remainder of the Balanomorpha. The facies similarity with pollicipoids is indeed most striking.

Virtually nothing more could be asked for in a generalized ancestor for the higher Chthamaloidea than *Catophragmus* and *Catomerus* — all the essential parts are there. All that needs

to be done is to modify the form, by loss or fusion of shell parts and loss or specialization of appendages and trophic structures, in order to produce the diversity of taxa presently observed within the superfamily (Fig. 4).

Relationships between genera have been noted by various authors. Pilsbry (1916:291) took a somewhat Gruvelian approach, and arrayed them in phylogenetic order, primarily according to number of wall plates. He also divided the most species-rich genus, *Chthamalus*, into two groups based on the nature of the mandible. These were refined and named informally by Nilsson-Cantell (1921) as the quadridentoid *Stellatus*-group and the tridentoid *Hembeli*-group.

Zullo (1963c) observed that the more generalized tridentoid mandible of the *Hembeli*-group was the type common to more primitive chthamaloids and, coupled with differences in mode of shell reduction, proposed that the Chthamalidae be divided into three groups: the quadridentoid *Chthamalus*, *Chamaesipho*, and *Octomeris*, and tridentoid *Catophragmus*, *Chionelasmus*, and *Euraphia*, and the tridentoid *Pachylasma*. The *Pachylasma*-group included *Hexelasma* (Zullo, 1963a). This is essentially Pilsbry's (1916:291) classification. Pope (1965), in a most scholarly review, pointed out some problems with the tri- and quadridentoid aspects of the division and this will be returned to shortly.

Although Utinomi (1968:36) avoided dealing with the problems that arise when using the mandibles as a key taxonomic character, he formally designated subfamilial divisions for what were essentially the Pilsbry-Zullo groupings: the Catophragminae (*Catophragmus*, *Catomerus*, and *Chionelasmus*), the Chthamalinae (*Chthamalus*, *Chamaesipho*, and *Octomeris*), and the Pachylasminae (*Pachylasma*, *Hexelasma*, and *Tessarelasma*). To the Catophragminae one must add the late Cretaceous *Pachydiadema* Withers (1935); to the Chthamalinae, the Recent *Tetrachthamalus* Newman (1967) and *Jehlius* Ross (1971); and from the Pachylasminae, or rather from the Chthamaloidea in general, remove *Hexelasma* and *Tessarelasma* (see Newman and Ross, 1971:142). We are otherwise in accord with Utinomi's groupings, but not as coordinate taxa (Fig. 4).

The Catophragmidae comprises an ancient and generalized stock; there is a significant gap between it and the remaining subfamilies. The differences, aside from the supplementary

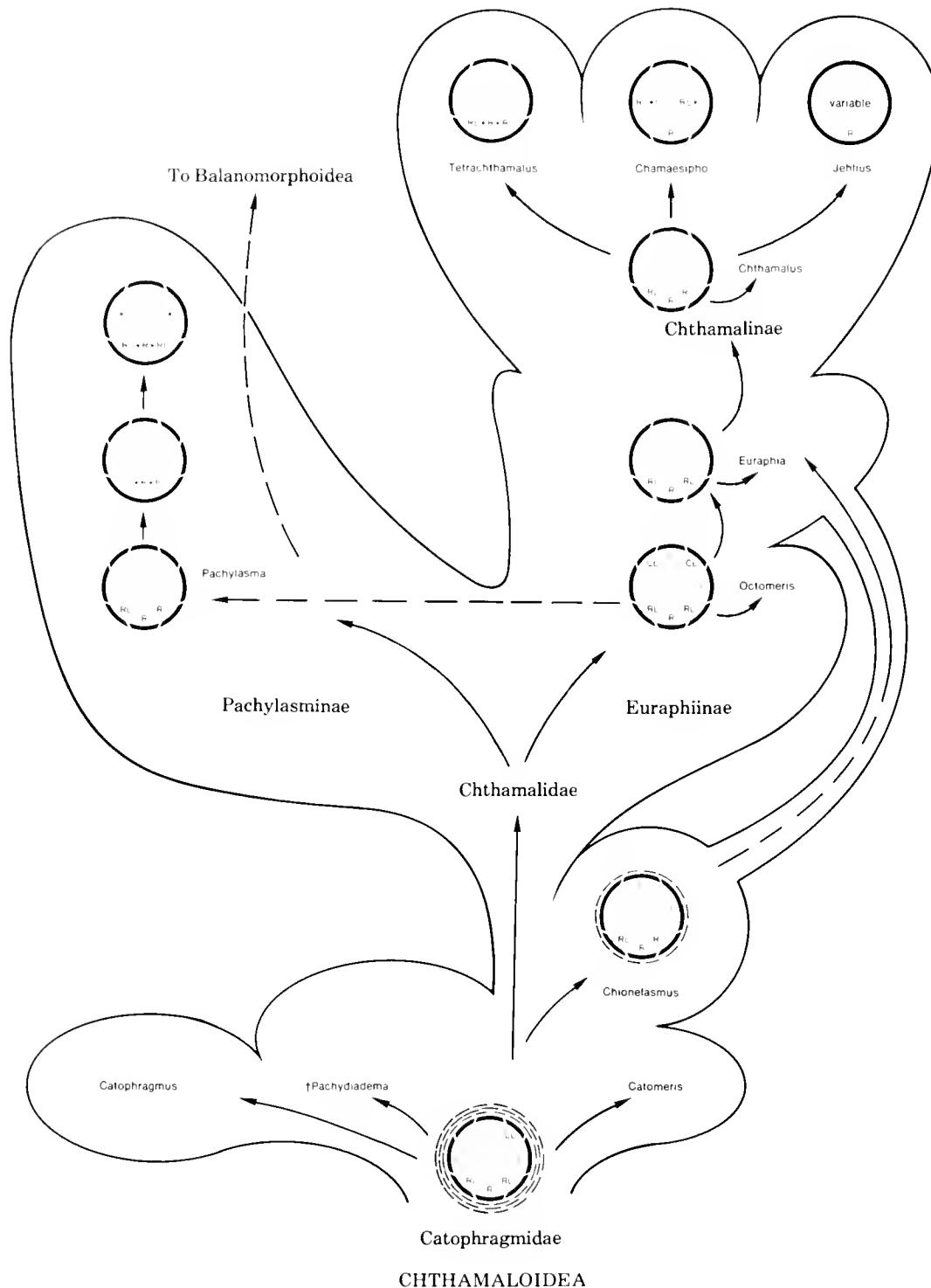


Figure 4. Radiation of the Chthamaloidea: It seems unlikely that *Chionelasmus* and *Pachylasma* (the only deep-sea members of the superfamily) evolved from intertidal catophragmids (*Catophragmus* and *Catomeris*) whose trophi and anterior cirri are much more specialized. By default then, the extinct *Pachydiadema* becomes a more likely candidate. It also seems unlikely, for the same reasons, that *Octomeris* gave rise to *Pachylasma*, or vice versa since the opercular valves of *Pachylasma* are already advanced. Finally, while it seems unlikely that *Chionelasmus* gave rise to six-plated euraphiines, the possibility cannot presently be ruled out.

If higher balanomorphans arose from chthamaloids, workers since and including Darwin (1854b) consider that it would have been via a pachylasmine ancestor (see text for further discussion).

whorls of plates in the Catophragmidae, are the extremely primitive nature of the primary wall plates and the opercular valves. Even in *Chionelasmus*, where the supplementary plates have been reduced to but a single whorl, and the primary wall plates from eight to six, the primitive pollicipoid facies is retained.

The jump from Catophragmidae to Chthamalidae is wholly in "modernization" of the wall, the arthropodal structures remain essentially the same in the primitive Euraphiinae and Pachylasminae, as do the number of primary wall plates. Whether catophragmides gave rise to these two subfamilies independently, or the apparently more generalized shallow water euraphian *Octomeris* gave rise to the deep-water Pachylasminae, cannot be resolved at this time.

Although the arthropodal structures seem to be similar, it is evident by shell characteristics that the euraphiines and pachylasmynes are not closely related. Zullo (1963c:190) emphasized that further advances in shell arrangement differ in the two groups. Consequently, it is clear that the pachylasmynes attained a six-plated condition by development of a compound rostrum, and the euraphiines by loss of the carinolaterals.

The transition from Euraphiinae to Chthamaliniae is clearly by way of *Euraphia*, and consists primarily of the first and only significant change in the trophic apparatus. This change, the development of the so-called quadridentoid mandible of Pilsbry and others, is probably an adaptation, along with the specialized setae (grapples or cards) on the anterior cirri, to life in the high intertidal, as suggested by Pope (1965:965).

The important feature of the quadridentoid mandible is probably not so much that there are four teeth, or that the second and third teeth are commonly bifid, but that the inferior portion rather than forming an angle supporting a group or tuft of spines, is drawn out into a relatively long straight comb. Nevertheless, Pope (1965:27) questioned the taxonomic value of this character. For example, she stated that the finding of "large individuals of certain Australian species (*Chthamalus antennatus*: 49) in which normally 4-toothed species have developed only 3 teeth, or conversely, of 3-toothed species (*Euraphia withersi*: 43) with 4 teeth, is going to make the drawing of distinctions between Zullo's generic groups somewhat difficult."

While there are difficulties in placing a few species in one or the other of these two groups, they are minor, and Pope herself explains most of them away. There is some variation in the

number of teeth in *E. withersi*, and Pope (1965:43) pointed out that the majority of specimens will be found to have three teeth, and under any circumstance, the inferior angle is pectinated, not combed. Thus there would appear to be no real difficulty here. And with regard to *C. antennatus*, Pope (1965:49) stated, "Sometimes mandibles of the right and left sides may vary and while the left one may have a *stellatus*-pattern for its lower tip, the right may have a "hembeli" one. However, in individuals with somewhat *hembeli*-like jaws, the small, fourth double tooth can be seen, thus enabling the real affinities of *C. antennatus* with *Chthamalus* to be recognized."

Pope (1965:58) goes on and provides further evidence that alleviates her own objection to the recognition of *Euraphia* as separate from *Chthamalus*. In *C. malayensis* "juveniles, or during regeneration in certain individuals, the lower tip of the mandible is reminiscent of the *Hembeli* pattern." She then (1965:59) notes that mandibles regenerating after having been damaged take on a euraphian form, and furthermore, that it seems as though juveniles and regenerating *C. antennatus* have to pass through a euraphian stage during the development of their much toothed and highly complex mandibles. The juvenile situation is clearly ontogenetic; it is indeed an ancestral euraphian reminiscence, as suggested by Pope, and that a regenerating limb would have to repeat the process is not surprising. Therefore, the distinction between mandibles in the two groups recognized by Pilsbry and used informally by Nilsson-Cantell seem not only to be useful taxonomically, but they aid in elucidating the evolution of higher chthamalids. A combed stellatoid mandible is seen elsewhere only in some Tetraclitidae, which also develop specialized cirral setae and occur high in the intertidal (Ross, 1970).

Despite the great age of the Chthamaloidea, the group has been relatively conservative, undergoing little diversification with regard to both structure and habitat. None (with the possible exception of certain *Pachylasma* on crinoids) has formed an obligate symbiotic association. The catophragmoid facies, first appearing in rocks of late Cretaceous age, was apparently an adaptation to high energy conditions along the shore and must have been abundant and widely distributed in the past. Extant species have restricted distributions in the austral region and the tropical Americas.

The most advanced catophragmid, *Chionelasmus*, and the relatively generalized chthamalid *Pachylasma* are presently the only deep-water

members of the entire superfamily — all others are intertidal. Where *Euraphia* and *Chthamalus* occur together the former and more generalized occupies the higher reaches of the intertidal, the highest of all balanomorphs (Pope, 1965; Southward, 1964b). Littoral and shallow water habitats that would otherwise appear suitable for chthamaloids are occupied, presumably through competitive exclusion and other biological interactions, by higher balanomorphoids and by balanoids.

## BALANOMORPHOIDEA

The Balanomorphoidea, proposed here, encompasses the Coronulidae, Bathylasmatidae and Tetraclitidae (Figs. 1 and 5). Taken together one finds a suite of fundamentally primitive or generalized characters, including 8 wall plates, membranous basis, generalized opercular plates, no basidorsal point on the penis, and a labrum and cirrus III of intermediate form.

Until recently the Tetraclitidae occupied an uncomfortable position as a subfamily of the Balanidae (Ross, 1968, 1970), whereas certain species of the Bathylasmatidae had been placed at one time in the Balanidae and at another in the Chthamalidae before being recognized as constituting a distinct family (Newman and Ross, 1971). The suite of characters that unites the Tetraclitidae and Bathylasmatidae under the Balanomorphoidea is the same as that which prevents their being satisfactorily assigned to either the Chthamalidae or Balanidae. The same holds true for the coronulid *Chelonibia*. But in addition it has 8 wall plates, a condition that previously complicated understanding the evolution of Balanidae. Our proposed reassignment of the coronulids to this superfamily not only removes this difficulty, but also allows for further insights into the fundamental organization and evolution of the balanomorphoids.

The intermediate position of *Hexelasma* s.l. and related genera between Chthamalidae and Balanidae, appeared ideal in arguments for derivation of the latter (Zullo, 1963c:190). However, it was shown (Bage, 1938; Newman and Ross, 1971:148) that the nature of the soft parts are not altogether intermediate, but rather possess many unique characteristics. Also, arguments requiring bathylasmatids as intermediate between chthamaloids and balanoids neglected the apparent eight rather than six-plated origin of the latter. Such arguments side-stepped what was considered a living representative of an early balanid, *Chelonibia*. At the same time,

the bathylasmatids could not be considered directly derivable from chthamalids, and because of *Chelonibia* they did not appear to be appropriate ancestors for the balanids. The obvious conclusion was that they must have had a separate origin, and probably then from a comparable pollicipoid lepadomorphan stock (Newman and Ross, 1971).

The preparation of this revision afforded us the opportunity to take a fresh look at the matter. We found that the apparent obstacle raised by *Chelonibia* was actually not a problem at all. As stated previously, and as will be given diagnostic documentation in the systematic account to follow, *Chelonibia* and its allies have hitherto been incorrectly placed among the Balanidae, and this has stifled our thinking on the matter. Once freed of this constraint the whole picture becomes simplified and eminently clearer. *Chelonibia* and other coronulids appropriately fall in the Balanomorphoidea.

Because of their extreme specialization as obligatory commensals of marine reptiles and mammals (Ross and Newman, 1967), what is known of the Coronulidae, beyond *Chelonibia*, tells us nothing about the evolution of the higher Balanomorphoidea. It is the Bathylasmatidae that provides us with the data base from which further inferences can be drawn.

The Bathylasmatidae form a natural group and we propose that it be divided into the subfamilies Bathylasmatinae and Hexelasminae (Fig. 5). Opercular valves are generalized in the former, and form a vertically oriented cone. In the latter, the opercular valves are more balanoid, and the plane of the scuta lies almost horizontal, across the orifice of the shell. Within the family, *Hexelasma* stands in an intermediate position between *Bathylasma* and *Aaptolasma*. However, it is more closely related to the latter and together they form the Hexelasminae.

Many features in *Aaptolasma* herald the Tetraclitidae. The comparable form of the mandible and labrum, the tendency for the third cirri to be antenniform, comparable opercular valves, and the peculiarity of the wall plates in being permeated by longitudinal chitin-filled tubes, are all characteristics that draw them together.

In the original diagnosis of *Aaptolasma*, only a small number of differences could be assembled to distinguish the genus from *Tetraclita* s. l., but at that time no six-plated tetraclitids were known. However, it subsequently became clear that *Balanus (Austrobalanus) imperator* Darwin was not just closer to *Tetraclita* than to *Balanus*, as Darwin (1854b:290) had recognized, but that it was a tetraclitid

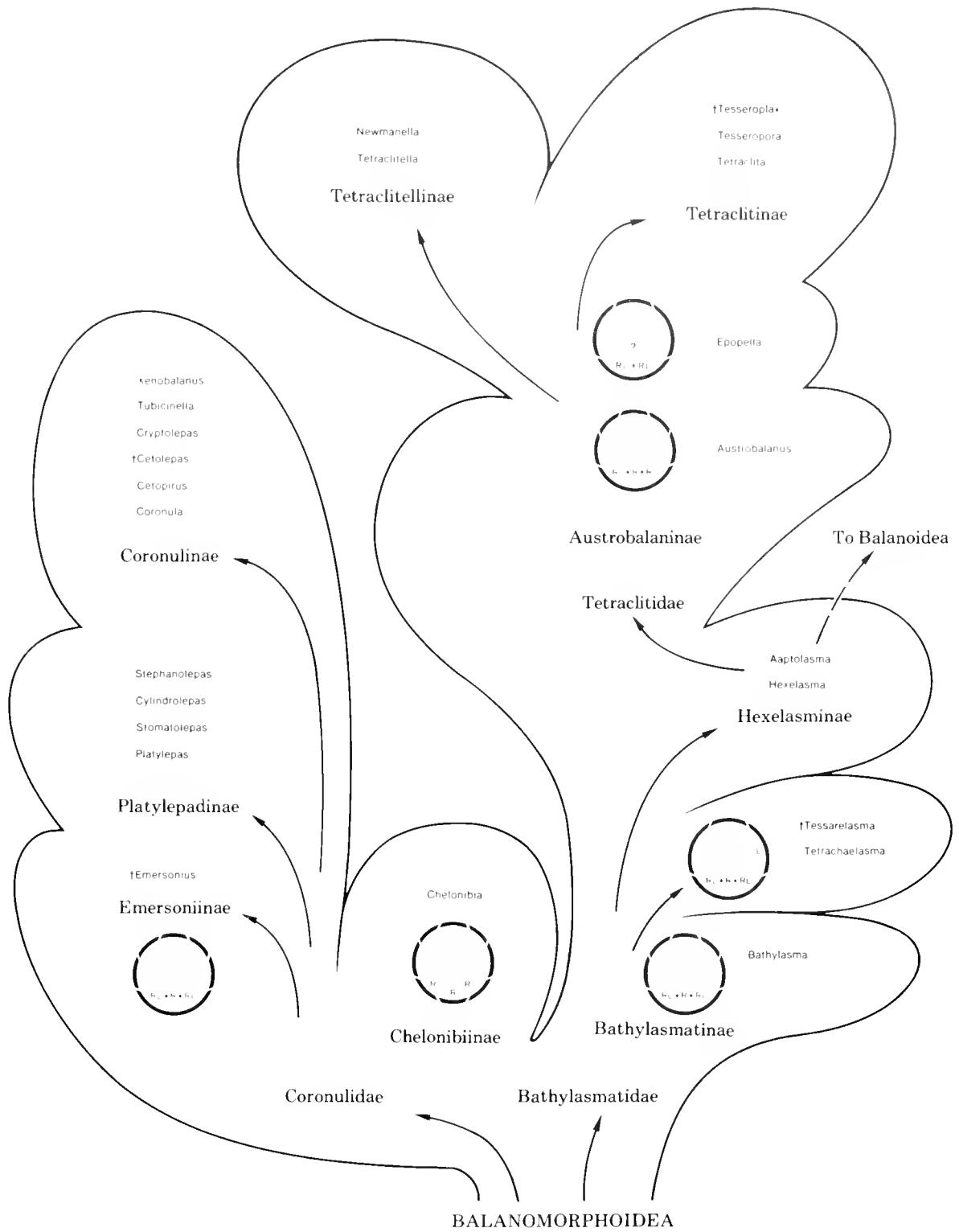


Figure 5. Radiation of the Balanomorphoidea: The Coronulidae are specialized obligate commensals of large crustaceans, some fish, sea turtles and snakes, and marine mammals. The Tetraclitidae are, on the other hand, specialized for an intertidal existence. These two families apparently did not give rise to higher forms. If the Balanoidea arose from the Balanomorphoidea, as proposed here, it probably would have been via the hexelasmidines, species of which are presently confined to the shelf (see text for further discussion).

(Ross, 1971:266). Thus a distinction based on the number of wall plates, between Hexelasmidae and Tetraclitidae, fails. What remains is that the tetraclitids have radii (at least fundamentally), cirri II and III commonly are armed with bipectinate and other complex setae, and the labrum is wholly non-bullate; all advances above the more generalized bathylasmid plan.

In *Aaptolasma*, the solid wall is permeated by strips of chitin in much the same manner as in certain tetraclitids (e.g. *Epopella*). All other tetraclitids have tubiferous walls whose characteristics provide the distinguishing features of the subfamilies.

There is a marked correlation between advances in specialization of appendages, shell wall, and bathymetry. The most generalized forms in the Bathylasmatidae occur at the greatest depths; in fact *Tetrachaelasma*, a close relative of *Bathylasma*, is the deepest known balanomorphan (2,300 m). Members of the Hexelasmidae occur on the shelf between approximately 100 and 1,000 m. All members of the Tetraclitidae on the other hand, like most Chthamaloidea, are intertidal or restricted to very shallow water. The hiatus between the low intertidal and 100 m or so is exploited by the Balanoidea. The Balanomorphoidea (except *Tesseropora* sp. on *Heliopora*, and the coronulids), like the Chthamaloidea, do not form obligate commensal relationships as do many members or groups of the Balanoidea.

## BALANOIDEA

It has been tacitly assumed that the Balanidae s. l. had an eight-plated ancestry, as did the chthamalids (cf. Newman et al., 1969). Darwin (1854b) pointed out the tripartite rostrum of the chthamalid *Pachylasma*, and of the presumed balanid *Chelonibia*. Runnström (1925) reported that the rostrum in *Balanus balanoides* formed ontogenetically by fusion of the rostro-laterals, and this has been interpreted as a reduction in the tripartite origin of the balanid rostrum. However, subsequent workers have failed to confirm this finding in this or any other balanid, much less a balanomorph.

Direct evidence of a tripartite rostrum is found in *Pachylasma* and in *Chelonibia*, but as already discussed, these genera fall near the stem of the Chthamaloidea and Balanomorphoidea, respectively, and are not directly involved in the origin of the Balanoidea. It follows then, that there is no evidence for a tripartite rostrum (eight-platedness) in the stem

of the Balanoidea. Nonetheless, it is appropriate that we review arguments to the contrary.

Zullo (1963c:190), following Darwin and Pilsbry suggested that the balanoids stemmed from the "Pachylasma-group." While not specifying which genera the group contained, he included *Bathylasma* (= *Hexelasma*, in part), and possibly *Bathybalanus*, as did Pilsbry (1916:291, 328). At the time, inclusion of these two genera previously unknown to Darwin, made acceptance of the group as the stem from which the balanoids could have arisen more palatable, for not only did they have the proper type of rostrum but also the appendages were considered to range from somewhat chthamaloid in *Bathylasma* to somewhat more balanoid in *Bathybalanus*. The labrum in *Bathylasma*, while not bullate as in chthamaloids, is relatively thick and lacks a deep median incision. Also, the third cirri are somewhat intermediate between the second and fourth pairs. The situation in *Bathybalanus* was thought to be comparable, although more balanoid. However, we have shown that *Bathybalanus* is in all respects a true balanid and that *Bathylasma*, while not a balanoid, is not a chthamaloid either (Newman and Ross, 1971:142). Furthermore, the *Pachylasma-Bathylasma-Bathybalanus-Balanus* s.l. transition from the chthamaloids to the balanoids by-passed *Chelonibia*, previously considered the only eight-plated balanoid. The problem of *Chelonibia* was removed in the preceding section of this paper, where it was shown that *Chelonibia* and its allies were primitive balanomorphoids rather than balanoids. We are left then with the prospect that the principal balanoid groups descended from balanomorphoidans rather than chthamaloids.

Early balanoids had a solid wall, as borne out by both fossil and ontogenetic evidence. The evolution of higher balanoids has in good part centered around the development of a complex wall, an evolutionary advance not achieved to any comparable degree in the chthamaloids (Darwin, 1854b), but paralleled in many respects in the higher balanomorphoids. At this point it is not difficult to envisage the Balanoidea as having descended from hexelasmine-like balanomorphoid ancestors, since the trends are already beginning there: comparably constructed wall of six plates, labrum thin and broadly notched, third cirri somewhat modified as maxillipeds, and balanoid opercular parts.

We include three families in the Balanoidea. The solid-walled forms, those included in *Semibalanus*, and those having irregular wall tubes of the non-balaninae type, such as found in *Archaeobalanus*, differ so markedly in wall

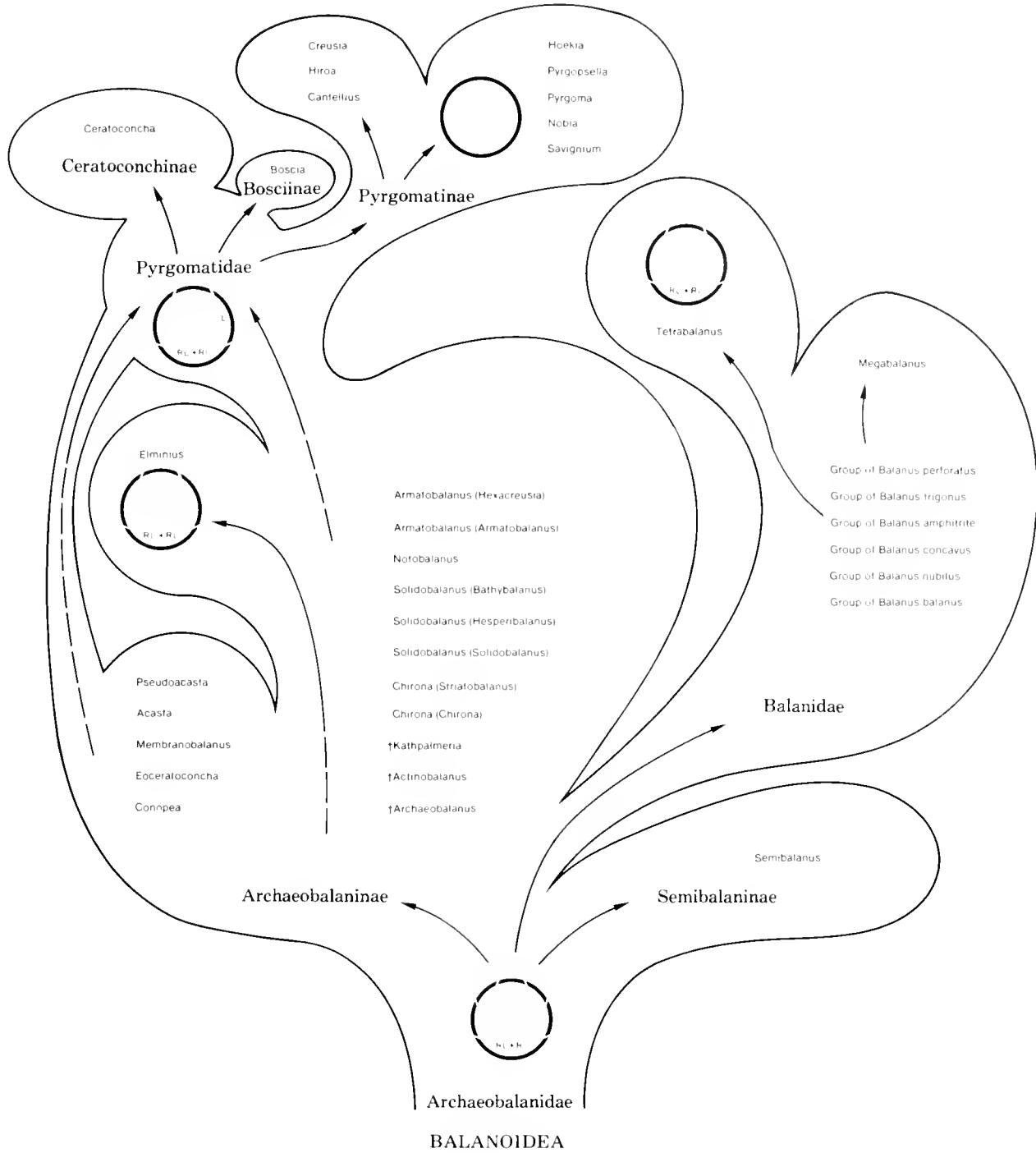


Figure 6. Radiation of the Balanoidea: A few of the more generalized balanoids, such as *Bathybalanus*, are found in deep water. But most free-living forms occur in relatively shallow water, and in the intertidal (Semibalaninae and Balanidae) where upper limits tend to set the lower limits of the chthamalid zone. Archaeobalanines, on the other hand, are usually subtidal and many have formed obligate commensal relationships (i.e. *Conopea* on gorgonians, *Acasta* on sponges, *Hexacreusia*, etc., on scleractinians). It is from the archaeobalanines that the Pyrgomatidae, occurring on scleractinians (one exception, on sponges), are inferred to have been derived, likely polyphyletically (see text for discussion).

structure from the Balanidae s.s., that we relegated them to two separate families — the Archaeobalanidae (including the Archaeobalaninae and Semibalaninae) and the Pyrgomatidae (including the Pyrgomatinae s.s., Bosciinae and Ceratoconchinae). Thus arranged, the archaeobalanids, which first appear in the Eocene, are envisaged as having stemmed from six-plated hexelasmid bathylasmatids or balanomorphoids.

The Archaeobalanidae fall into two subfamilies, the more diverse Archaeobalaninae and the strictly intertidal Semibalaninae. The *Archaeobalanus*-like forms with tubiferous walls have undergone the most marked diversification of any of the balanomorphs. They are well represented in the intertidal even though the higher reaches have been left to the tetraclitid balanomorphoids and most chthamaloids. The semi-balanines which may have an *Actinobalanus* ancestry, apparently did not give rise to any higher taxa.

Two families stem from the Archaeobalaninae. They are fundamentally the solid-walled Pyrgomatidae and the tubiferous-walled Balanidae. The Pyrgomatidae encompasses the coral barnacles and, while the monophyletic origin of the group is in question (Withers, 1929a; Ross and Newman, 1973; Newman and Ladd, 1974), the consensus is that some, particularly those contained in the principal subfamily, the Pyrgomatinae, and possibly the Bosciinae, have descended from *Armatobalanus* (Zullo, 1969b, 1967:127; Ross and Newman, 1973). The Ceratoconchinae apparently had a different and apparently non-armatobalanid origin (Newman and Ladd, 1974).

The Balanidae, as envisaged here, may have stemmed from an irregularly tubiferous-walled ancestor having a calcareous basis such as *Archaeobalanus*. In the Balanidae the principal evolutionary advance was the establishment of a regular tubiferous wall in conjunction with an intricate dovetailing between the marginal portion of the internal ribs of the wall and the margins

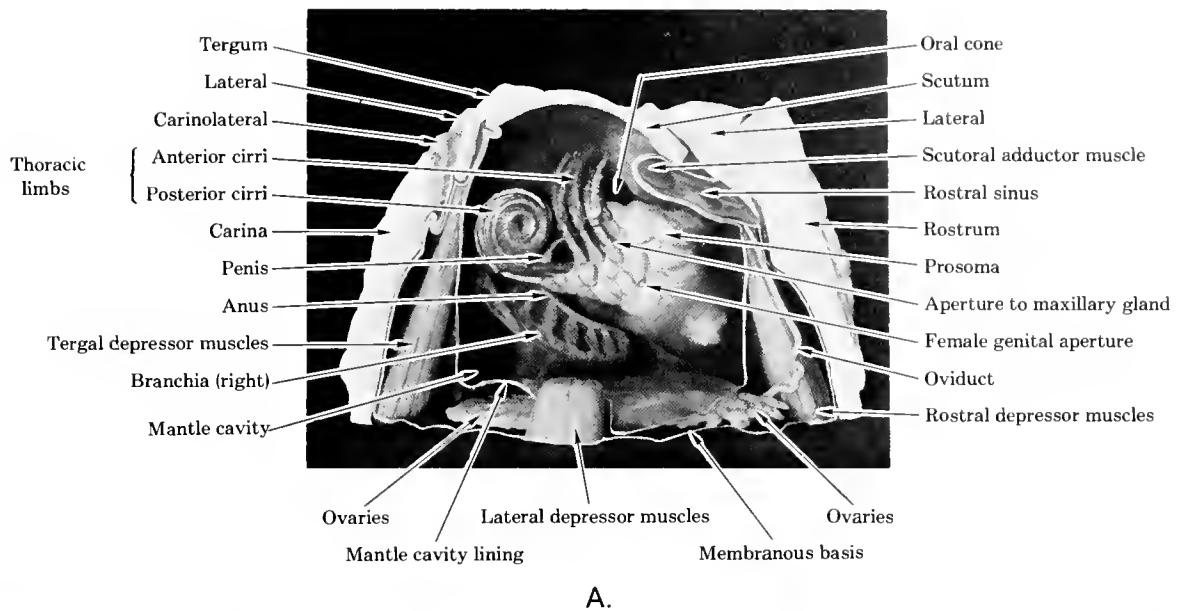
of the basis, thereby enabling an individual to continue to grow diametrically while maintaining a strong mechanical interlock with the substratum (Newman et al., 1967). Perfection of this system, including delayed application of an inner lamina to the internal ribs of the wall, produced the unique tubiferous structure distinguishing balanids from all other Balanomorpha. Tubiferous walls occur in other Balanomorpha (Pyrgomatidae, Semibalaninae, and Archaeobalaninae among the Balanoidea, and the Coronulidae and Tetraclitidae among the Balanomorphoidea (Darwin, 1854b; Newman et al., 1967; Ross and Newman, 1967; Ross and Newman, 1973), but differences in ontogeny and the nature of the resultant structures indicate separate origins.

The Balanidae is the most diverse family, and Pilsbry (1916:78 et seq.) began to group species of *Balanus* s.s., informally, into eight "series." However, he did not follow through with the matter in his monograph, and today only the "Series of *B. amphitrite*" is commonly referred to in the literature. We have attempted to follow Pilsbry's lead, and have arranged the species of *Balanus* in six more or less natural groups. While some of these are readily recognizable by a number of characters, others have been assigned on the basis of undefined facies similarities. Thus, while some of the groups may eventually become genera or subgenera, such a proposal at the present would be premature. Those species that we could not readily assign to one group or another are placed *incertae sedis*, at the end of the catalogue.

A considerable part of the diversification of the Balanoidea has come about through establishment of obligate symbiotic relationships verging on, but in only one case becoming wholly parasitic (*Hoekia* on the coral *Hydnophora*, Ross and Newman, 1969). If the present epoch goes down in the fossil record as the "Age of Barnacles," as suggested by Darwin (1851a:5), it will in good part be due to the remains of symbiotic as well as free-living forms.

## MORPHOLOGY

The figures appearing on the following ten pages illustrate various features of the shell and appendages of balanomorphans. The figures are arranged sequentially, beginning with the shell and ending with the appendages. In those figures where comparisons are made, the arrangement is essentially phylogenetic.



B.

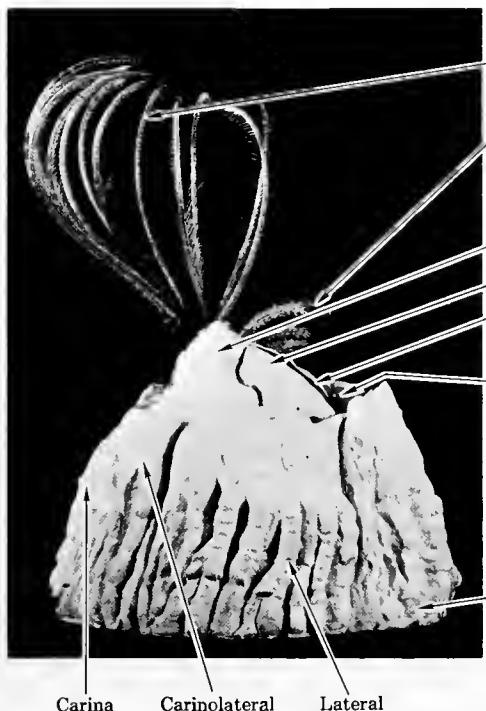


Figure 7. Model of *Semibalanus balanoides* (L.): A and B, viewed from left side; C, viewed from rostral end (frontal aspect). In A, the left carinolateral and lateral wall plates as well as the left tergum and scutum have been removed revealing the interior of the mantle cavity containing the body of the animal as it resides when withdrawn. B, as A, but with the missing parts replaced and the cirri extended. The posterior three pairs of cirri (in Balanoidea and some Balanomorphoidea) form the cirral net while the anterior three pairs act primarily as maxillipeds. In C, it can be observed how the cirral net is formed and how the anterior cirri are positioned to aid in transferring food from it to the oral cone. Photographs courtesy of the American Museum of Natural History.

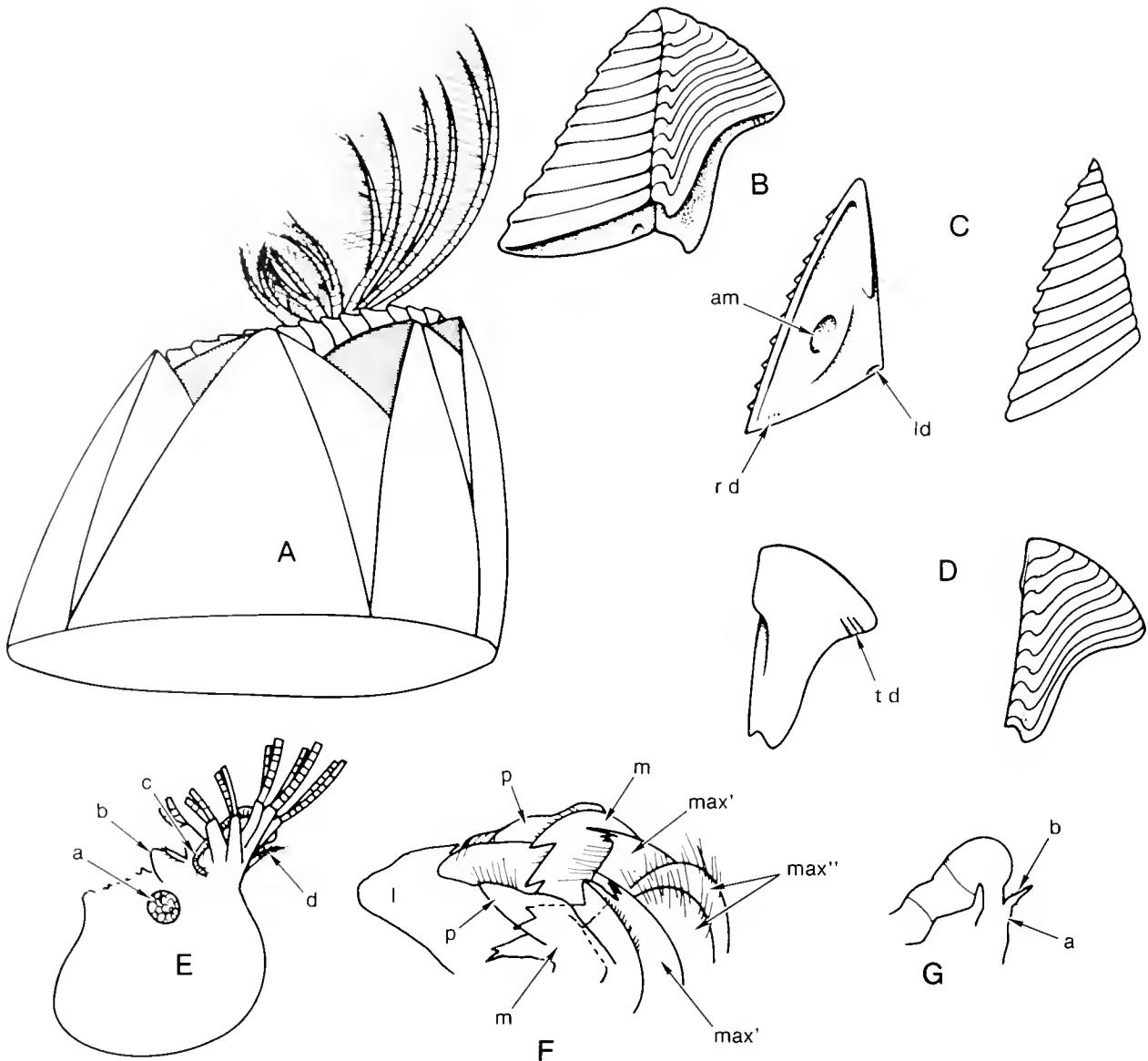


Figure 8. Principal anatomical relationships:

A. A balanomorph montage\*, viewed from the right side, with right cirri extended from aperture formed between the occludent margins of the opercular valves, primarily the scuta. The six cirri are always biramous. The posterior three form the right half of the plankton-capturing cirral net, while the anterior three are reduced and otherwise modified, primarily as "maxillipeds," for removal of food from the cirral net (cf. Figs. 14-16). Cirri are extended by circulatory hydrostatic pressure and withdrawn by retractor muscles.

B. The tentorial operculum, composed of paired terga and scuta, attaches along its basal margin to the lower margin of the sheath and is operated by three principal pairs of longitudinal depressor muscles, a transverse adductor between the scuta, and circulatory hydrostatic pressure.

C. and D. Exploded operculum illustrating scuta and terga respectively. (am, insertion of adductor muscle; rd, insertion of rostral depressor; ld, of lateral depressor; td, of tergal lateral depressor).

E. Body torn free from its attachment in the operculum and surrounding mantle (carapace), exposing the adductor muscle (*a*), the oral cone or labrum surrounding mouthparts (*b*), the pedicles and proximal portions of the right cirri, the penis (*c*) originating between the sixth cirri and resting for the most part between the pedicles of the adjacent pairs, and the right caudal appendage or ramus of the caudal furca (*d*).

F. Oral cone enlarged, illustrating arrangement of trophi, from left to right: Labrum (*l*) with mandibular palps (*p*) attached to each side, followed by mandibles (*m*) and first and second maxillae (*max'*, *max''*).

G. Basal region of a balanid penis illustrating gross form of the pedicel (*a*) and basidorsal point or horn (*b*).

\*A fully bullate labrum and caudal appendages are characteristics of lower cthamalids, while much reduced third cirri and a penis with a basidorsal point are characteristics of balanids (see subsequent illustrations). A pair of outgrowths of the interior mantle lining extends into the mantle cavity in which the body of the barnacle resides. These, termed branchiae, are variable in structure between taxa, but their taxonomic value is yet to be determined. They have been little used in systematic studies and consideration of them has not been included here.

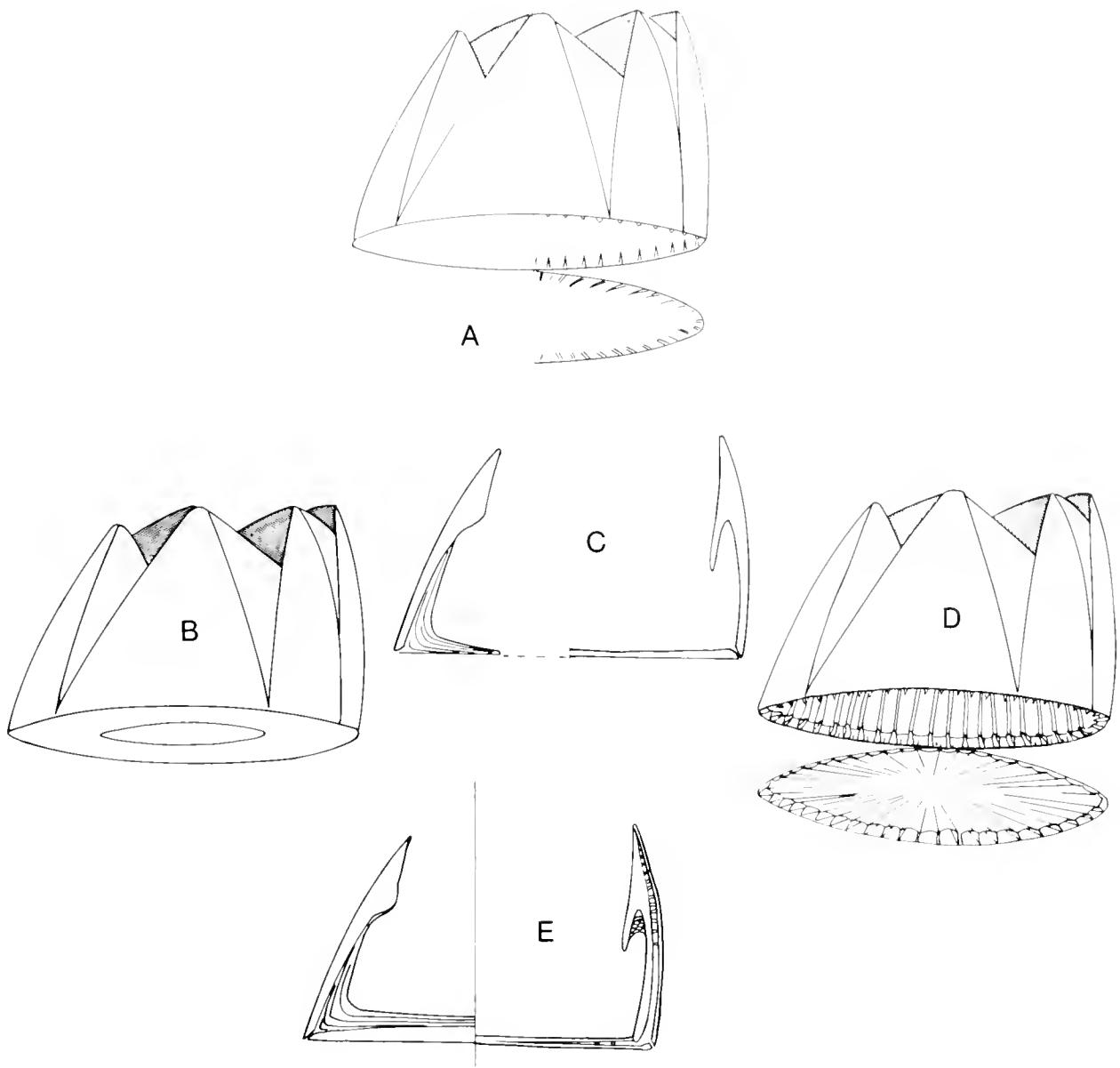


Figure 9. The balanomorph wall; modifications of basic plan and nature of the basis:

A. Wall of six solid plates; basis on left (not indicated) membranous, on right calcareous. In the latter, the basal margin of the wall may form some minor denticles, the older portions of which may appear as riblets on the interior of the wall, but the denticles form neither complex interdigitation with the basis nor anything other than very simple interlaminar figures in cross-sections of the wall (cf. Fig. 12A, B).

B. As above, but with a "false basis" which may not, as in *Euraphia intertexta*, include the central portion of the membranous basis.

C. Longitudinal sections of wall. Left, false basis, formed by successive layers of secondary calcification, in which fusion to the wall precludes further growth. Right, true basis indicating suture where marginal growth increments can occur. Various thickened apical portions of wall (sheath) support the opercular valves. The sheath is ordinarily solid and its basal margin may become dependent (right). When a dependent sheath contacts ribs on the interior of the wall a type of tubiferous wall is formed, but the sheath does not constitute a true inner lamina (some coronulids and pyrgomatids).

D. Tubiferous wall, in this case accompanied by a tubiferous basis. Well developed, uniformly deployed basal denticles form complex interdigitation with the basis which in turn is firmly cemented to the substratum. When, with growth, the inner portions of the denticles become secondarily fused, forming an inner lamina, the type of tubiferous wall seen here appears (Balanidae). If the denticles are simple, the interlaminar figures will be simple; if they have subsidiary lateral cusps, the interlaminar figures will be complex (cf. Fig. 12H, I).

E. Longitudinal sections of wall. Left, a form with solid wall and basis where growth has been precluded by secondary calcification (false basis, as in some species of *Euraphia*). Right, a situation where transverse septa have developed in the tubiferous wall and basis, and where the cavity formed by the dependent sheath has become secondarily filled and/or cancellated. Aforegoing structural developments can occur in various combinations.

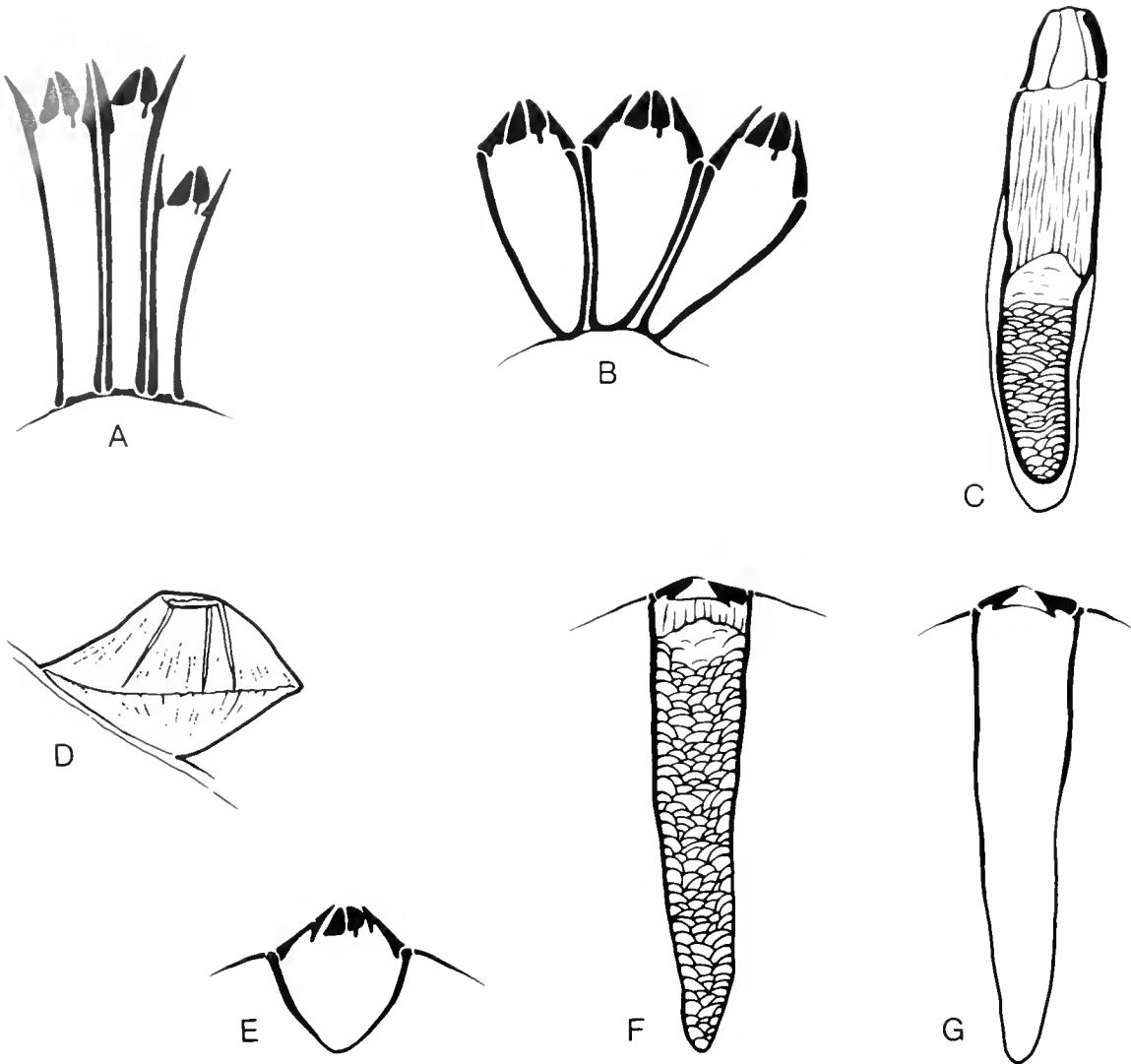


Figure 10. The balanomorph wall; modifications of the basic plan. Fundamentally balanomorphs grow diametrically, increasing in height and basal width by depositing new shell around the basal parietal margins, and the size of the aperture is increased by additions to the lateral parietal margins to varying degrees (Darwin, 1854b). When lateral increments are negligible or absent, the aperture is often enlarged by corrosion, as in *Tetraclita*. Other variations in the fundamental plan are illustrated here.

A-C. Alterations in growth in gregarious species due to crowding.

A. Pattern in forms such as *Semibalanus balanooides* and *Balanus glandula* (without or with carcareous bases respectively) where normally conical forms become columnar through elongation of the parieties.

B. Alternative response to crowding, as seen in species of *Megabalanus* and members of the *concavus* group of *Balanus*, where elongation is primarily accomplished by the formation of a cup-shaped basis. The basis may be permeated by one or numerous rows of tubes.

C. Situation in some species producing a cup-shaped basis, such as some species of the *concavus* group and in *Balanus laevis* (illustrated), where the extensive cavity formed by elongation of the basis becomes secondarily transversely septate (cancellate or cystose).

D. Growth in symbiotic forms, such as *Acasta* imbedded in sponges and *Conopea* (illustrated) occurring on gorgonians, in which a cup-shaped basis is formed. In the former it apparently assists in maintaining the apertural end of the barnacle at the surface of the growing sponge and (or) in enlarging the body chamber without forcing the wall above the surface of the sponge. In the latter, it elevates the barnacle well above the general surface of the gorgonian, the "keel" of its boat-shaped basis attaching firmly to the gorgonian axial skeleton.

E-G. Coral barnacles keep pace with the surface of the coral, generally by elongation of the basis.

E. As seen in species of *Armatobalanus* and *Boscia*, where elongation of the basis is not extensive and growth of the wall elevates the barnacle above the surface of the coral.

F and G, where elongation is extensive and the wall plates grow so as to remain more or less flush with the coral surface, as in *Eoceratoconcha* and most members of Ceratoconchinae and Pyrgomatinae. In *Eoceratoconcha* and an early species of *Ceratoconcha*, the chamber formed by the basis is cancellate (F), while in most members of the Pyrgomatidae it is open (G).

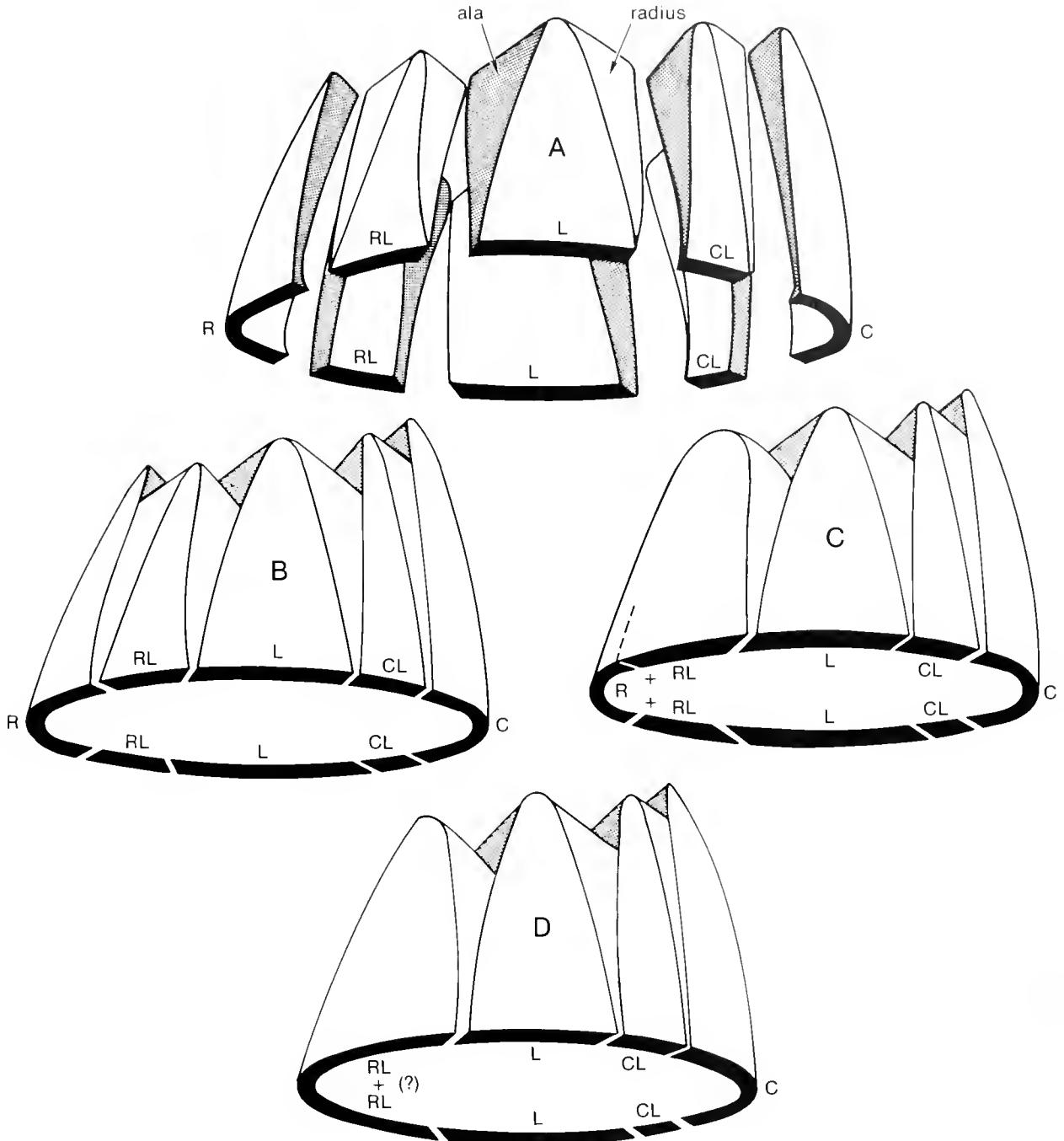


Figure 11. The balanomorph wall; parts and relationships of plates (schematic):

A. Exploded eight-plated wall viewed from the right side. The plates are named, from left to right, the rostrum (R), paired rostrolaterals, laterals and carinolaterals (RL, L and CL, respectively) and the carina (C). The central triangular portion of each plate is termed the paries (pl. parietes). The basal margin (blackened portion) contacts the substratum. Contacting surfaces between adjacent plates are stippled, and the portion seen from the exterior is termed the ala (pl. alae). The parietal margin overlapping an ala may develop a lateral portion which fills the space between it and the adjacent paries. This structure is termed a radius (pl. radii). Parietes can be solid or permeated by longitudinal tubes; radii (except in *Megabalanus* and some Tetractitidae) and alae are always solid. It can be observed that the rostrum and carina have alae, the rostrolaterals have radii on both margins while the laterals and carinolaterals have alae on their rostral and radii on their carinal margins.

B. An articulated eight-plated wall (as in lower Catophragmidae and Chthamalidae).

C. Eight-plated wall in which the rostrolaterals have become inseparably but discernibly fused to the rostrum forming a "compound rostrum" (as in some species of *Pachylasma* and in *Chelonibia*). A true rostrum has alae and is overlapped by adjacent plates, while a compound rostrum has radii and overlaps adjacent plates.

D. Compound rostrum where fusion demarcations are no longer discernible. May consist of fused rostrolaterals and rostrum, or fused rostrolaterals alone (see text for discussion of divergent views).

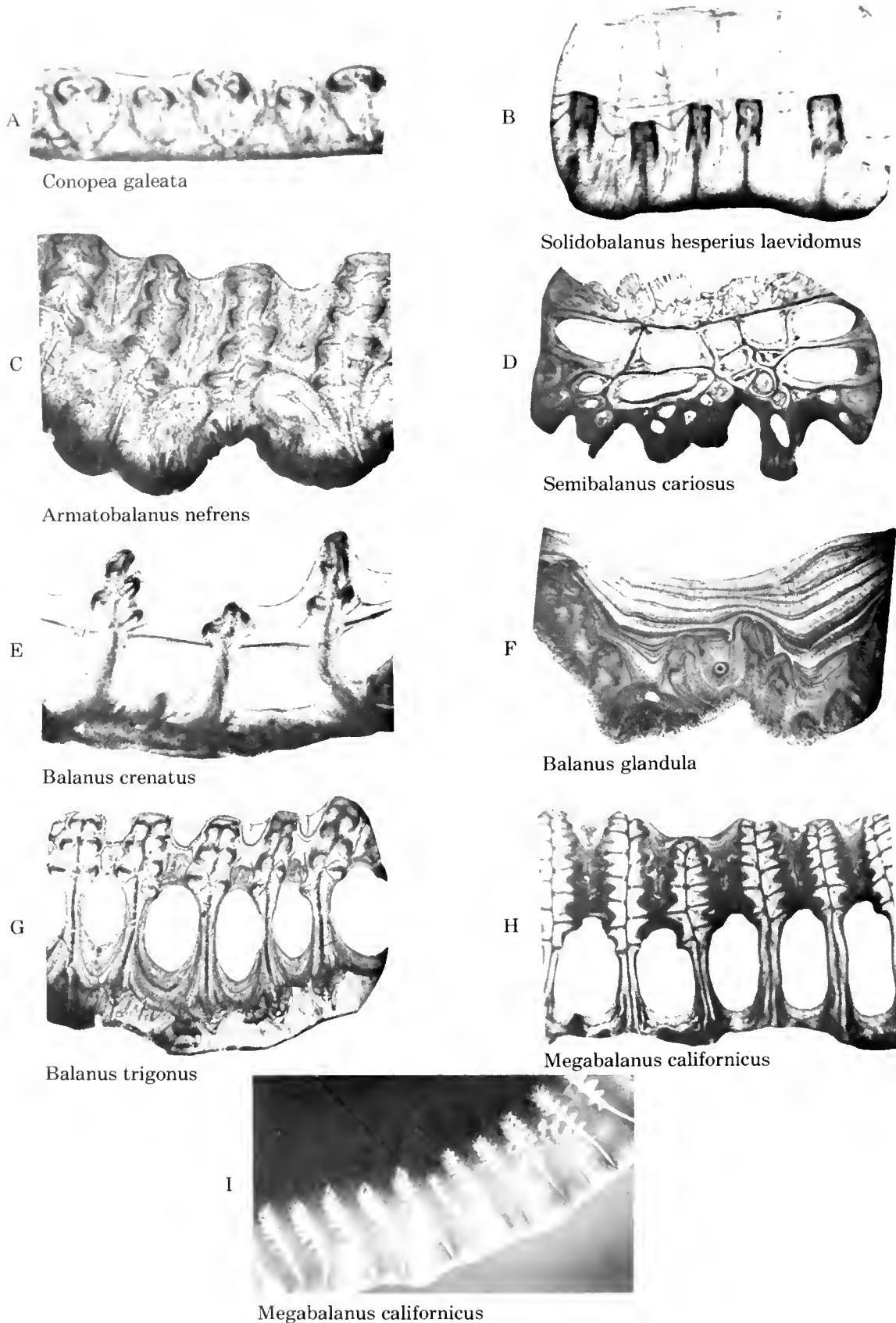


Figure 12. Wall structure in some Balanoidea. See caption on page 35.

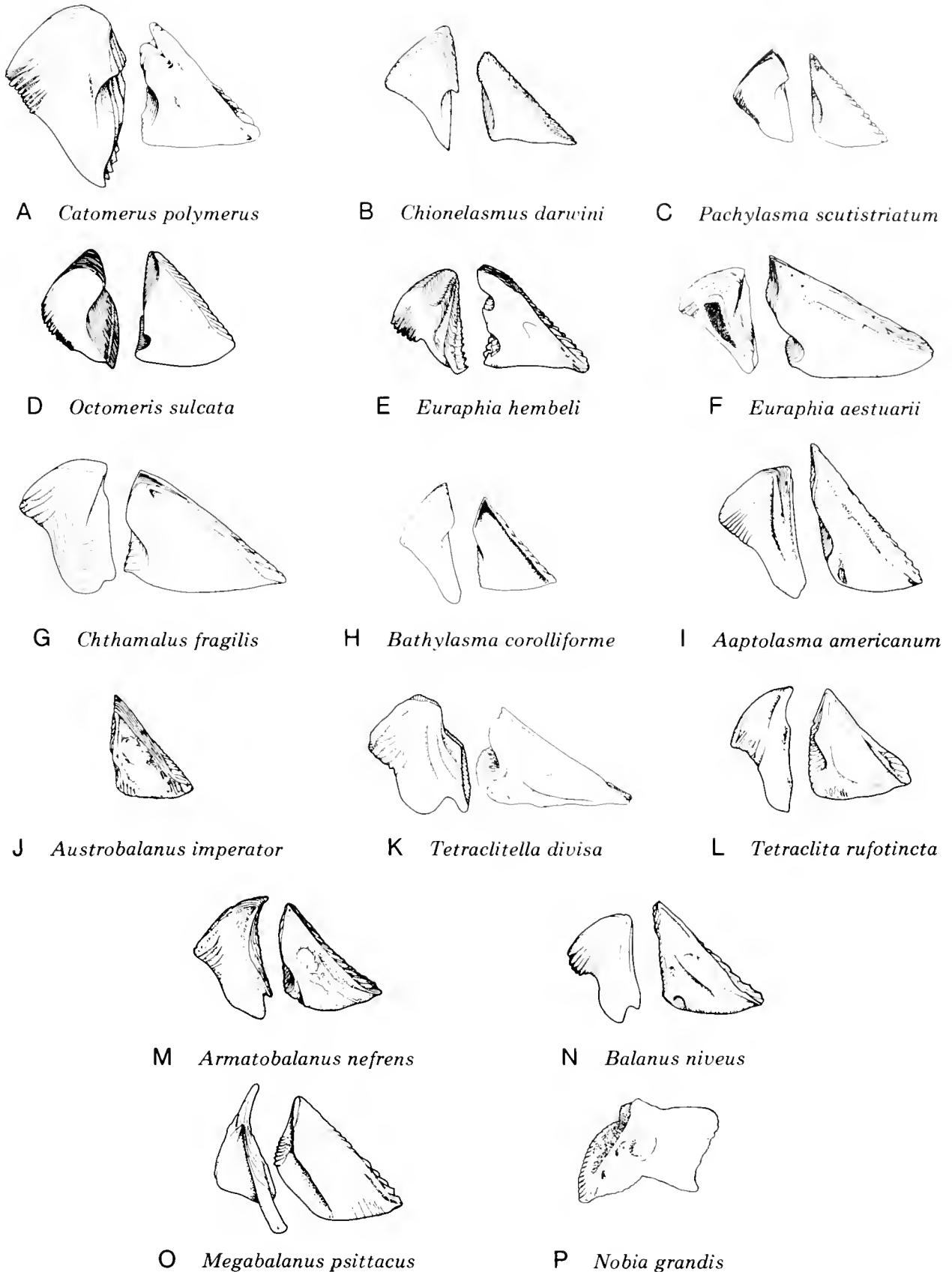
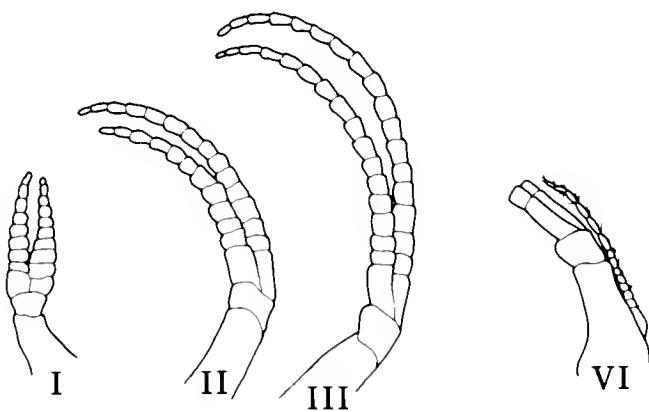
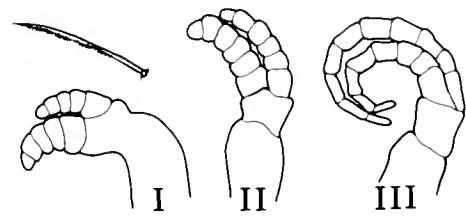
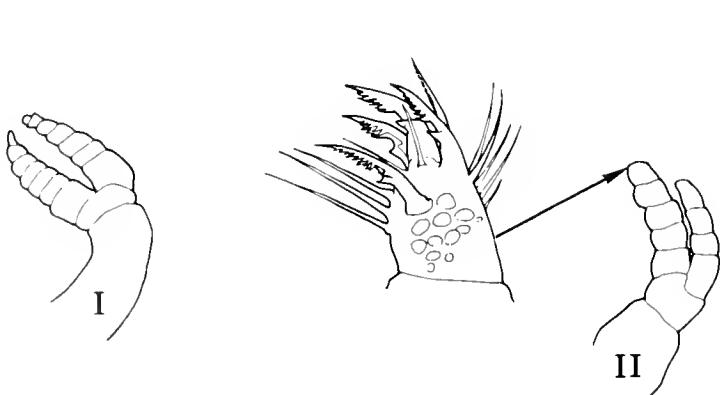


Figure 13. Opercular plates of the Balanomorpha. See caption on page 35.

A *Chionelasmus darwini*B *Euraphia intertexta*C *Tetrachthamalus obliteratus*D *Chionelasmus darwini*E *Euraphia intertexta*F *Tetrachthamalus obliteratus*

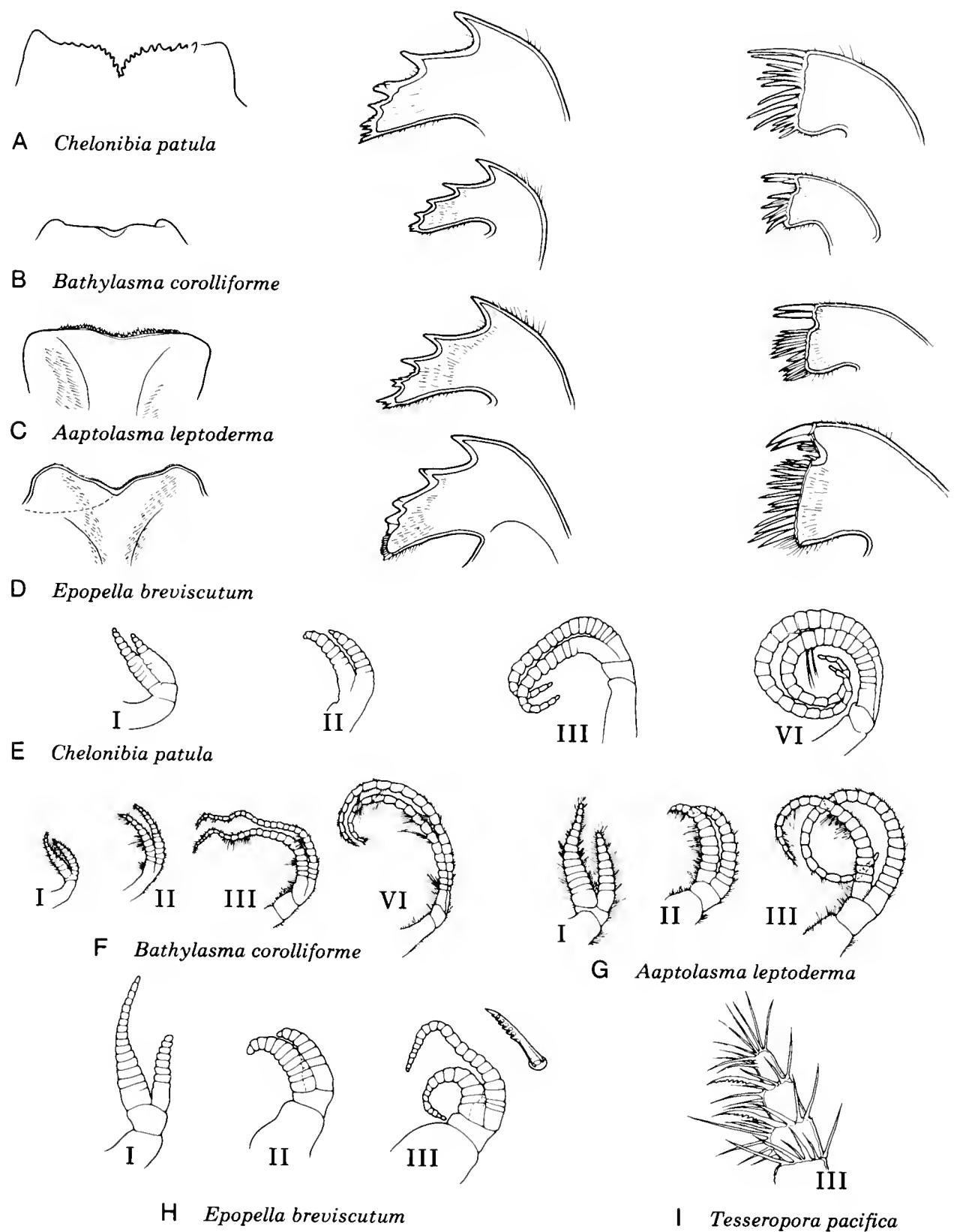


Figure 15. Trophi and cirri of Balanomorphoidea. See caption on page 35.

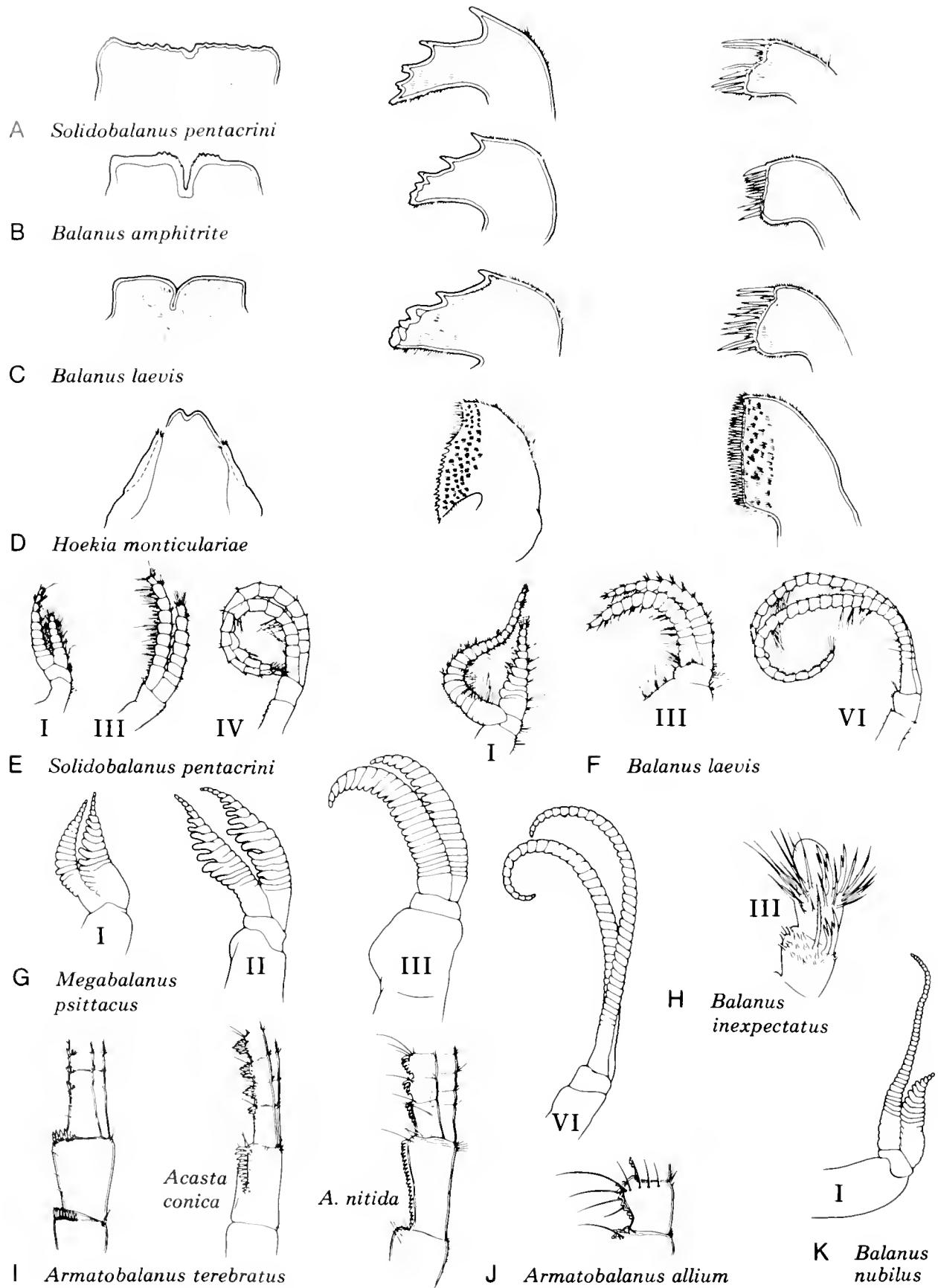


Figure 16. Trophi and cirri of Balanoidea. See caption on page 35.

Figure 12. Wall structure in some Balanoidea. A-H, transverse thin sections; I, photograph of basal margin. Increments resulting in vertical growth of the shell are due to deposition of new shell along the basal margin of the plates. In primitive forms lacking a calcareous basis (most Chthamaloidea and the lower Balanomorphoidea and Balanoidea) transverse sections reveal little complexity in gross structure. With the advent of a calcareous basis there is an opportunity for a complex suture to form, interlocking the wall to the substratum through the basis. In solid wall forms the interlocking is generally accomplished by a regular array of simple denticles, the development of which is that of planar mineralized entities along centers of calcification, and these are visible as simple interlaminar figures in the older portion of the shell (A and B). If subsidiary denticles are produced perpendicular to the main denticle (as in I), the interlaminar figures will be arborescent (in solid walled forms as in C; in tubiferous walled forms as in E, G and H). Some species without calcareous bases have tubiferous walls, and transverse sections commonly appear as in D. Some basically tubiferous walled species with calcareous bases have given up denticle formation and have all but completely filled irregularly formed tubes (F).

Figure 13. Opercular plates of the Balanomorpha: A-G, Chthamaloidea; H-L, Balanomorphoidea; M-P, Balanoidea (all right terga and scuta, viewed from within). In the chthamaloids, terga tend to be triangular in outline (without spur, except in higher forms like *Chthamalus fragilis* [G] where a rudimentary spur is developed), scuta never develop a strong adductor ridge, and the terga and scuta of each side tend to be deeply articulated especially in shallow-water forms (A and D-G).

The situation in the balanomorphoids is somewhat intermediate between that seen in the chthamaloids and lower balanoids; a tergal spur is variously developed, an adductor ridge becomes prominent in higher forms (J-L) and the plates of shallow water forms are less deeply articulated. (In the first two superfamilies the tergum is never beaked and a spur furrow, where developed, is always open.)

Lower balanoids tend to resemble higher balanomorphoids except that the adductor ridge is not particularly strong and the insertions of the scutal depressor muscles are simple. Closure of the spur furrow (a result of the shaft of the spur becoming virtually internal), occasionally accompanied by production of a beak (O), apparently develops independently in various lines (within Semibalaninae, members of the *Balanus concavus* group, and *Megabalanus*). Partial or complete fusion of terga and scuta of each side occurs in all three superfamilies, but marked alterations in general form occur primarily in the coral symbionts (Pyrgomatinae, P). The whale-turtle symbionts (coronulids) have reduced the opercular plates, and in *Xenobalanus* they have been lost completely.

Figure 14. Trophi and cirri of the Chthamaloidea: A and D, *Chionelasmus darwini*; B and E, *Euraphia intertexta*; C and F, *Tetrachthamus obliteratus*. Trophi of lower chthamaloids are similar to those pollicipoid scalpellids — labra are bullate with crests variously concave but without a median notch (A and B); the mandibular teeth may have spinous superior margins (B); and the cutting edges of the first maxillae are usually stepwise or notched. In Chthamalinae (C) the mandibular teeth are never spinose, the second and third teeth are frequently bifid, a fourth bifid tooth is developed and the inferior portion is drawn out into a straight comb with the inferior angle supporting but a few spinules, and the cutting edge of the first maxillae tends to be straight and slightly notched.

The third cirri in general tend to resemble the fourth more than the second (E and F) but in *Chionelasmus* (D) even the second are more similar to the posterior ones. Specialized setae, ranging from bipectinate (E) to pinnate (F) are generally found on the second cirri. Posterior rami of the third cirri may be antenniform (F), apparently seasonally in intertidal forms. The caudal appendages or furca, a pair of uniramous appendages attached near the bases of the sixth cirri, and commonly found in lepadomorphans, are known in a few chthamaloids (D).

Figure 15. Trophi and cirri of Balanomorphoidea: A and E, *Chelonibia patula*; B and F, *Bathylasma corolliforme*; C and G, *Aaptolasma leptoderma*; D and H, *Epopella breviscutum*; I, *Tesseropora pacifica*. Labra of balanomorphoids are similar to those of chthamaloids in being thick (although not bullate) and with variously concave crests (although there is a tendency to form a shallow notch). In *Chelonibia* (A) the labrum is distinctly notched and multidenticulate, in a manner reminiscent of *Balanus amphitrite* (Fig. 16 B). Mandibles of lower forms (A-C), in generally having four major teeth and pectinate inferior angles, are similar to lower balanoids (Fig. 16, A). In higher tetrachitines (D) the inferior portion becomes comblike, much as in higher chthamaloids (Fig. 14, C), apparently an adaptation to life in the high intertidal. The first maxillae are essentially balanoid. The third cirri resemble the fourth more than the second (E-G), as in chthamaloids, or one or both rami are antenniform or bear specialized serrate setae (F, H and I).

Figure 16. Trophi and cirri of Balanoidea. A and E, *Solidobalanus (Bathybalanus) pentacrini*; B, *Balanus amphitrite amphitrite*; C and F, *Balanus laevis*; D, *Hoekia monticulariae*; G, *Megabalanus psittacus*; H, *Balanus amphitrite inexpectatus*; I, *Armatobalanus (Armatobalanus) terebratus*, *Acasta conica* and *Acasta nitida* respectively; J, *Armatobalanus allium*, K, *Balanus nubilus*. Labra of balanoids are generally thin and deeply incised; mandibles tend to have molariform rather than pectinated or combed inferior portions; first maxillae are undistinguished (B and C). In primitive species (A), the labrum has but a shallow notch and the mandible, in having an incisiform inferior portion, resembles that of the lower balanomorphoids. Marked departures from this facies are seen in commensal forms such as the wholly parasitic coral barnacle, *Hoekia* (D).

The third cirrus always more closely resembles the second than the fourth, even in primitive species (E), and its rami are never antenniform. Rather, it is the anterior ramus of the first cirrus that takes on antenniform characteristics in some higher forms (F and K). Anterior cirri become variously thickened and in species without markedly specialized setae or spines, the anterior margin of the articles may become markedly protuberant (G). Complex setae, as seen in many chthamaloids and higher balanomorphoids, are not found in balanoids. Conversely, the so-called furcate (H) and multifurcate types found in certain species of the group of *Balanus amphitrite* (Henry, 1973) have not been observed in the first two superfamilies. On the other hand, complicated arrays of spines commonly develop in balanoids (I and J), in free living forms, but especially in commensals of sponges and corals where they may be used to clear the aperture and prevent overgrowth by the host.

## COMPOSITION AND DEFINITIONS OF SUPRAGENERIC TAXA

An abbreviated definition is given for all suprageneric taxa. Where appropriate, the type genus and related genera are indicated. For each genus, the author, date and page, and the number of fossil and extant species included are given.

### BALANOMORPHA Pilsbry (1916: 14)

Thoracic cirripeds lacking peduncle; bilaterally symmetrical shell composed of carina, rostrum, and one to three pairs of lateral compartmental plates that may be variously fused or totally concrescent; opercular valves paired when present, with members of each pair separate, articulated or concrescent; hermaphroditic (a few species of Archaeobalaniniae have complementary males).

### CHTHAMALOIDEA Darwin (1854b: 446)

n. status

Wall composed of rostrum and one to three pairs of laterals; rarely supplemented with one or more whorls of imbricating plates around basal margin; rostrum rarely compound; parietes solid; radii solid; internally wall lacks uniform ribs; articulation of opercular valves generally deep, articulating pairs occasionally secondarily cemented or calcified together; basis commonly membranous, when calcareous, solid, and not forming complex interdigitations with wall; labrum bullate; crest nearly straight or shallowly concave, but without medial incision; mandible tri- or quadridentoid, with teeth usually simple; inferior angle finely pectinate or coarsely serrate; cirrus III resembling IV more than II; cirrus II frequently with specialized terminal setae; cirri lacking specialized hooks and spines; anterior ramus of cirrus III occasionally antenniform; penis without basidorsal point; caudal appendages when present multiarticulate.

### CATOPHRAGMIDAE Utinomi (1968a: 36)

n. status

Wall of 8 or 6 plates; having one or more basal whorls of supplementary plates; mandible tridentoid.

Genera: *Catophragmus* Sowerby (1826: 328), type genus, 1 sp.; *Catomerus* Pilsbry (1916: 335), 1 sp.; *Pachydiadema* Withers (1935: 389), 1 sp.; *Chionelasmus* Pilsbry (1911: 82), 1 sp.

### CHTHAMALIDAE Darwin (1854b: 446)

Wall of 8, 6, or 4 plates; lacking basal whorl of supplementary plates; mandible tridentoid or quadridentoid.

### PACHYLASMINAE Utinomi (1968a: 36)

Wall of 8, 6, or 4 plates; wall sutures finely denticulate; rostrum compound or with weakly developed alae; scutum higher than wide; basis commonly calcareous; mandible tridentoid; commonly with caudal appendages.

Genus: *Pachylasma* Darwin (1854b: 475), type genus, 9 spp.

### EURAPHIINAE n. subfam.

(Group of *C. hembeli*,  
Nilsson-Cantell, 1921: 275)

Wall of 8 or 6 plates; sutures often coarsely serrate; rostrum with well developed alae; scutum higher than wide; basis commonly calcareous; mandible tridentoid; generally lacking caudal appendages.

Genera: *Euraphia* Conrad (1837: 261), type genus, 10 spp.; *Octomeris* Sowerby (1825: 326), 3 spp.

### CHTHAMALINAE Darwin (1854b: 446)

(Group of *C. stellatus*,  
Nilsson-Cantell, 1921: 275)

Wall of 6 or 4 plates; sutures usually finely denticulate; rostrum with well developed alae or rarely compound; scutum wider than high; basis membranous; mandible quadridentoid; teeth two through four commonly with subsidiary cusps; generally lacking caudal appendages.

Genera: *Chthamalus* Ranzani (1817: 276), type genus, 24 spp.; *Jehlius* Ross (1971b: 269), 1 sp.; *Tetrachthamalus* Newman (1967a: 425), 1 sp.; *Chamaesipho* Darwin (1854b: 470), 3 spp.

### BALANOMORPHOIDEA n. superfam.

Wall composed of rostrum, carina, and one to two pairs of laterals; rostrum compound; parietes solid or tubiferous; when tubiferous often secondarily filled with chitinous and(or) calcareous material; radii solid or tubiferous; internal surface of compartments generally without uniform ribs; articulations between pairs of opercular valves generally shallow, valves never calcified together secondarily; basis commonly

membranous, when calcareous solid and not forming complex interdigitations with wall; labrum thick, weakly bullate; crest nearly straight or shallowly concave, frequently with median depression, rarely with medial incision; mandible quadridentoid; teeth simple or teeth two through four with subsidiary cusps; inferior angle finely pectinate or coarsely serrate; cirrus III resembling II more than IV or more or less intermediate between II and IV; cirri without specialized spines or hooks, but cirri II and III may be armed with specialized setae; rami of cirrus III normal, or inner, outer or both rami antenniform; penis lacking basidorsal point; caudal appendages lacking.

#### CORONULIDAE Leach (1817: 68)

Wall of 8 (rostrum discernibly tripartite) or 6 plates; plates of six-plated forms with or without a median longitudinal sulcus; parietes tubiferous; tubes formed between inner and outer lamina, between internal buttresses, or between external ribs; interlaminate figures simple, dendritic or anastamosing; radii solid; basis membranous; opercular plates when present, reduced, not articulated and not occluding aperture.

#### CHELONIBIINAE Pilsbry (1916: 262)

Wall of 8 or 6 plates, each lacking a median longitudinal sulcus; opercular plates weakly articulated; terga well developed; borders of mantle not forming a hood over the cirri; one row of confluent wall tubes formed between inner and outer lamina.

Genera: *Chelonibia* Leach (1817: 68), type genus, 12 spp.

#### EMERSONIINAE Ross (1967: 7)

Wall presumably of 6 plates, each lacking a median longitudinal sulcus; several rows of vertically discontinuous wall tubes between inner and outer lamina.

Genus: *Emersonius* Ross (*in* Ross and Newman, 1967: 7), type genus, 1 sp.

#### CORONULINAE Leach (1817: 68)

Wall of 6 plates, each lacking a median longitudinal sulcus; terga vestigial; opercular plates lacking in *Xenobalanus*; borders of mantle forming a hood over the cirri; single row of wall

tubes formed by infoldings of outer lamina against the sheath.

Genera: *Coronula* Lamarck (1802: 464), type genus, 8 spp.; *Cetopirus* Ranzani (1817: 276), 1 sp.; *Cetolepas* Zullo (1969a: 17), 1 sp.; *Cryptolepas* Dall (1872: 300), 2 sp.; *Tubicinella* Lamarck (1802: 461), 1 sp.; *Xenobalanus* Steenstrup (1851: pl. 3), 1 sp.

#### BATHYLASMATIDAE Newman and Ross (1971: 138)

Wall of 6 or 4 plates; parietes solid and lacking regular internal ribs, or with chitin-filled longitudinal tubes arranged in a single row; plates lacking radii; inferior margin of mandible commonly pointed, bearing a few small spines; all cirri lacking specialized setae; one or both rami of cirrus III and occasionally cirrus II may be antenniform.

#### BATHYLASMATINAE n. status

Wall of 6 or 4 plates; wall not permeated by tubes; basis membranous, but inner shelf may form by secondary calcification; scuta oriented essentially perpendicular to basis; tergum lacking distinct spur; cirrus II resembling III more than I.

Genera: *Bathyasma* Newman and Ross (1971: 143), type genus, 3 spp.; *Tessarelasma* Withers (1936: 591), 1 sp.; *Tetrachaelasma* Newman and Ross (1971: 152), 1 sp.

#### HEXELASMINAE n. subfam.

Wall of 6 plates; permeated by chitin-filled tubes; basis calcareous; scuta oriented essentially parallel to basis; tergum with distinct spur; cirrus II resembling I more than III.

Genera: *Hexelasma* Hoek (1913: 224), type genus, 3 spp.; *Aaptolasma* Newman and Ross (1971: 158), 5 spp.

#### TETRACLITIDAE Gruvel (1903b: 160)

Wall of 6 or 4 plates; parietes solid, or permeated by chitin, or having one or more rows of tubes containing living tissue or secondarily filled with calcareous and chitinous material; radii well developed or obsolete, basis commonly membranous; inferior margin of mandible pectinate or coarsely serrate; cirrus II and III commonly armed with specialized setae; inner or outer or both rami of cirrus III either normal or antenniform.

## AUSTROBALANINAE n. subfam.

Wall solid, or permeated by chitinous rods or lamellae; radii solid, narrow or obsolete.

Genera: *Austrobalanus* Pilsbry (1916: 218) in part, ref. to *B. imperator* only,<sup>1</sup> type genus, 1 sp.; *Epopella* Ross (1970: 3), 3 spp.

## TETRACLITELLINAE n. subfam.

Wall tubiferous; tubes never filled; radii tubiferous or solid, broad, well developed.

Genera: *Tetraclitella* Hiro (1939e: 273), type genus, 10 spp.; *Newmanella* Ross (1969: 242), 1 sp.

## TETRACLITINAE Gruvel (1903: 160)

Wall tubiferous; tubes commonly partly filled with chitinous and calcareous material; radii solid, narrow or obsolete:

Genera: *Tetraclita* Schumacher (1817: 91), type genus, 18 spp.; *Tesseropora* Pilsbry (1916: 259), 5 spp.; *Tesseroplax* Ross (1969: 241), 1 sp.

## BALANOIDEA Leach (1817: 68) n. status

Wall composed of rostrum, carina, and one to two pairs of lateral compartments, or wholly concrecent; parietes solid or tubiferous, when tubiferous rarely secondarily filled; radii solid or tubiferous; when basis calcareous internal surfaces of compartments commonly with uniform ribs; basis commonly calcareous, solid or permeated by tubes, rarely membranous; when calcareous commonly forming complex interdigitations with wall; opercular valves occlude aperture; articulations between pairs generally shallow, or fused; labrum thin, never bullate; crest with pronounced medial incision; mandible quadri- or quinquideterminate; second and following teeth with one or more subsidiary cusps; fifth tooth often vestigial; inferior angle commonly molariform; cirrus III resembling II more than

<sup>1</sup>Darwin (1854b: 290) noted, on the basis of several shell characters and the nature of the third cirrus, that *Balanus imperator* was closer to *Tetraclita* than to *Balanus*, but he nonetheless assigned it to *Balanus*. Pilsbry (1916: 218) proposed the subgenus *Austrobalanus*, with *Balanus imperator* as the type species. However, Ross (1971: 266) noted that *imperator* was not a *Balanus*, but a six-plated tetraclitid, and subsequent studies on arthropodal structures confirms this affinity; *Austrobalanus imperator* is assigned to the Tetraclitidae herein. This change necessitates erecting a new genus for the remaining three taxa originally assigned to *Austrobalanus* by Pilsbry. We propose *Notobalanus* Ross, herein (Gr. *notos*, southern, and *Balanus*), with *Balanus flosculosus* Darwin, 1854b, as the type species, and assign this genus to the Archaeobalanidae herein. The species assigned to *Notobalanus* may be characterized as follows: shell small, non-tubiferous; inner basal surface bears irregular ridges; radii narrow; basis calcareous, and non-tubiferous; scutum with crests for insertion of lateral depressor muscle.

IV; cirri usually without specialized setae, but not infrequently armed with specialized hooks and spines; rami of cirrus II or III never antenniform; rami of cirrus I subequal or grossly unequal; lacking caudal appendages; penis with basi-dorsal point (rudiment thereof in Semibalaninae).

## ARCHAEOBALANIDAE n. fam.

Wall of 6 or 4 plates; parietes solid, rarely tubiferous; tubes uniformly or irregularly arranged and formed between inner and outer laminae; when regularly arranged interlaminate fingers simple, linear; radii solid; basis commonly calcareous, rarely tubiferous.

## ARCHAEOBALANINAE n. subfam.

Wall of 6 or 4 plates; parietes solid or tubiferous; when tubiferous, tubes uniformly arranged in single row; interlaminate figures simple; basis calcareous or membranous, when membranous wall solid.

Genera: *Archaeobalanus* Menesini (1971: 9) type genus, 1 sp.; *Actinobalanus* Moroni (1967: 923), 7 spp.; *Kathpalmeria* Ross (1965a: 61), 2 spp.; *Armatobalanus* s. s. Hoek (1913: 159), 15 spp.; *Armatobalanus (Hexecreusia)* Zullo (1961b: 72), 2 spp.; *Chirona* s. s. Gray (1835: 37), 6 spp.; *Chirona (Striatobalanus)* Hoek (1913: 159), 8 spp.; *Solidobalanus* s. s. Hoek (1913: 159), 15 spp.; *Solidobalanus (Hesperibalanus)* Pilsbry (1916: 192), 15 spp.; *Solidobalanus (Bathybalanus)* Hoek (1913: 230), 1 sp.; *Notobalanus* n. gen., 3 spp.<sup>1</sup>; *Elminius* Leach (1825: 210), 3 spp.; *Membranobalanus* Hoek (1913: 159), 7 spp.; *Acasta* Leach (1817: 69), 54 spp.; *Conopea* Say (1822: 323), 16 spp.; *Pseudoacasta* Nilsson-Cantell (1930b: 11), 1 sp.; *Eoceratoconcha* Newman and Ladd (1974: 387), 2 spp.

## SEMIBALANINAE n. subfam.

Wall of 6 plates; parietes tubiferous; basally tubes irregularly spaced, not in discrete rows; interlaminate figures lacking; basis membranous.

Genus: *Semibalanus* Pilsbry (1916: 182), type genus, 5 spp.

## PYRGOMATIDAE Gray (1825: 104)

Wall of 4 plates or wholly concrecent; parietes solid or tubiferous; when tubiferous tubes occur between outer lamina and sheath, or between external ribs of wall; interlaminate figures complex, essentially arborescent; radii solid; basis calcareous, rarely tubiferous, membranous in *Pyrgopsella*.

PYRGOMATINAE Gray (1825: 102)

Wall of 4 plates or wholly concrescent; opercular valves normal or modified; when normal, tergum with weakly developed lateral depressor muscle crests, or crests lacking; when shell concrescent, sheath lacking paired sulci.

Genera: *Pyrgoma* Leach (1817: 68), type genus, 1 sp.; *Cantellius* Ross and Newman (1973: 150), 17 spp.; *Creusia* Leach (1817: 68), 3 spp.; *Hiroa* Ross and Newman (1973: 153), 1 sp.; *Hoekia* Ross and Newman (1973: 161), 1 sp.; *Nobia* Sowerby (1823: no pagination), 6 spp.; *Savignium* Leach (1825: 210), 4 spp.; *Pyrgop-sella* Zullo (1967a: 123), 2 spp.

CERATOCONCHINAE n. subfam.

Wall of 4 plates; opercular valves normal; tergum with a single large crest for lateral depressor muscle.

Genus: *Ceratoconcha* Kramberger-Gorjanović (1889: 50), type genus, 21 spp.

BOSCIINAE n. subfam.

Wall wholly concrescent; opercular valves normal; tergum with feebly developed lateral depressor muscle crests, or crests lacking; sheath with paired sulci.

Genus: *Boscia* Ferussac (1822: 145), type genus, 4 spp.

BALANIDAE Leach (1817: 68)

Wall of 6 or 4 plates; parietes tubiferous; tubes basically in single uniform row formed between inner and outer laminate although supplementary tubes may form basally; inter-laminate figures complex, arborescent; radii either solid or tubiferous; basis calcareous, commonly tubiferous.

Genera: *Balanus* DaCosta (1778: 248), type genus, 131 spp.; *Megabalanus* Hoek (1913: 158), 49 spp.; *Tetrabalanus* Cornwall (1941: 227), 1 sp.

## CATALOG OF SPECIES

Superfamily Chthamaloidea Darwin, 1854, n. status  
 Family Catophragmidae Utinomi, 1968

Genus *Catophragmus* Sowerby, 1826

*Catophragmus imbricatus* Sowerby, 1827, figs. 1-6

SYNONYMY DIAGNOSIS: Henry, 1958: 217.

REFERENCES: Broch, 1922:298 (as *Catophragmus pilosbryi* n. sp.); Darwin, 1854b:490; Gruvel, 1905a:196; Pilsbry, 1916:335; Verrill, 1901:22; Weltner, 1897:274.

DISTRIBUTION: Atlantic: Antigua, Bermuda; Pacific: Panama, Costa Rica.

Genus *Pachydiadema* Withers, 1935

*Pachydiadema cretaceum* Withers, 1935:390

DISTRIBUTION: Upper Senonian (Cretaceous), Ifo, Sweden (Withers 1953:103).

Genus *Catomerus* Pilsbry, 1916

*Catomerus polymerus* (Darwin), 1854b:487

SYNONYMY DIAGNOSIS: Pope, 1965:16.

REFERENCES: Barnes & Klepal, 1971:79 (pedicel of penis); Broch, 1922:299, 301; 1927a:506; Bennett & Pope, 1953: 105; 1960:182; Dakin et al., 1948:176; Endean et al., 1956:88; Gruvel, 1903b:111; 1905a:195; Guiler, 1952:20; Nilsson-Cantell, 1926:8; Pilsbry, 1916:336; Pope, 1945:356; Weltner, 1897:274; Wisely & Blick, 1964:162 (first stage nauplii); Womersley & Edmonds, 1958:217.

DISTRIBUTION: Southeast Australia.

Genus *Chionelasmus* Pilsbry, 1911

*Chionelasmus darwini* (Pilsbry), 1907c:188.

SYNONYMY DIAGNOSIS: Nilsson-Cantell, 1928b:446.

REFERENCES: Gordon, 1970:105; Nilsson-Cantell, 1938b:14; Pilsbry, 1911:82; 1916:335; Pope, 1965:10.

DISTRIBUTION: Hawaii; Rodriguez Is., Western Indian Ocean; 450-460m.

Family Chthamalidae Darwin, 1854

Subfamily Pachylasminae Utinomi, 1968

Genus *Pachylasma* Darwin, 1854

*Pachylasma aurantiacum* Darwin, 1854b:480

SYNONYMY DIAGNOSIS: Darwin, 1854b:480.

REFERENCES: Gruvel, 1905a:199; Weltner, 1897:273.

DISTRIBUTION: New South Wales, Australia.

*Pachylasma chinense* Pilsbry, 1912:293

SYNONYMY DIAGNOSIS: Pilsbry, 1912:293.

REFERENCE: Pilsbry, 1916:329.

DISTRIBUTION: East China Sea; 400m.

*Pachylasma crinoidophilum* Pilsbry, 1911:81

SYNONYMY: Utinomi, 1968a:24.

DIAGNOSIS: Pilsbry, 1911:81; Utinomi, 1968a:24.

REFERENCES: Kruger, 1911b:460; Nilsson-Cantell, 1932a: 14; Utinomi, 1958a:307.

DISTRIBUTION: Tokyo Bay to Kyusyu, Japan; 300-400m.

*Pachylasma darwinianum* Pilsbry, 1912:293

REFERENCE: Pilsbry, 1916:329.

DISTRIBUTION: Sulu Arch.; 150m.

*Pachylasma ecaudatum* Hiro, 1939b:52

SYNONYMY/DIAGNOSIS: Utinomi, 1968a:31 (as *Hexelasma ecaudatum*).

DISTRIBUTION: Ogasawara I.; 200m.

*Pachylasma giganteum* (Philippi), 1836:250

SYNONYMY/DIAGNOSIS: Darwin, 1854b:477.

REFERENCES: Gruvel, 1905a:198; Kolosváry, 1942c:143;

1943a:77; 1951c:412; Pilsbry, 1916:329; Relini, 1969:169; Stubbings, 1967:263; Weltner, 1897:273; Withers, 1953: 60, 61.

DISTRIBUTION: Mediterranean (Sicily); West coast of Africa. Tertiary: Messina, Sicily.

*Pachylasma integrirostrum* Broch, 1931:50

DISTRIBUTION: Kei Is.; 140m.

*Pachylasma japonicum* Hiro, 1933:65

SYNONYMY/DIAGNOSIS: Utinomi, 1958a:22.

REFERENCE: Hiro, 1937c:430.

DISTRIBUTION: Southwest coast of Japan; 55-364m.

*Pachylasma scutistriata* Broch, 1922:301

SYNONYMY/DIAGNOSIS: Utinomi, 1968a:26.

REFERENCE: Nilsson-Cantell, 1927a:781.

DISTRIBUTION: Southern Japan, South China Sea to S. Australia; 132-2050m.

### Subfamily Euraphiinae n. subfam.

Genus *Octomeris* Sowerby, 1825

*Octomeris angulosa* Sowerby, 1825:244

SYNONYMY: Barnard, 1924:98.

DIAGNOSIS: Darwin, 1854b:483.

REFERENCES: Barnes & Barnes, 1965a:391 (variation in egg size); Barnes & Klepal, 1971:79 (pedicel of penis); Gray, 1825:104 (as *O. stuchburii* n. sp.); Gruvel, 1903b: 109; 1905a:197; Hiro, 1932b:478; Nilsson-Cantell, 1938b: 12; Pilsbry, 1916:334; Ritz & Foster, 1968:545 (temperature responses); Sandison, 1954:69 (nauplii); Stebbings, 1910:575; Weltner, 1897:274.

DISTRIBUTION: South Africa.

*Octomeris brunnea* Darwin, 1854b:484

SYNONYMY/DIAGNOSIS: Pope, 1965:20.

REFERENCES: Barnes & Klepal, 1971:79 (pedicel of penis); Gruvel, 1903b:110; 1905a:197; Hiro, 1932b:471; 1939e: 252 (includes discussion of *O. intermedia*); Nilsson-Cantell, 1921:303 (as *Octomeris intermedia* n. sp.); 1925: 1; 1930b:10; 1931a:108; 1932a:13; 1938b:33 (as *O. intermedia*); Utinomi, 1949a:25; 1954:22; 1958a:307; Weltner, 1897:274; Withers, 1932:123 (as *O. crassa* n. sp.).

DISTRIBUTION: Southern Japan; Philippines; Indonesia; New Hebrides; Australia; Mergui Arch.

*Octomeris sulcata* Nilsson-Cantell, 1932a:8

SYNONYMY: Utinomi, 1970:345.

DIAGNOSIS: Hiro, 1939e:254.

REFERENCES: Hiro, 1932b:471; 1939d:242; 1939f:207; Ooishi, 1964:195; Rosell, 1973b:75; Utinomi, 1949a:21; 1970:345; Utinomi & Kikuchi, 1966:5.

DISTRIBUTION: Southern Japan to Formosa.

Genus *Euraphia* Conrad, 1837

*Euraphia aestuarii* (Stubbings), 1963b:7

SYNONYMY: Stubbings, 1967:257.

DIAGNOSIS: Stubbings, 1963b:7.

REFERENCES: Gauld, 1957:10 (as *Chthamalus stellatus depressus*); Kolosváry, 1941b:70 (as *Chthamalus cirratus*); 1943a:75 (as *Chthamalus cirratus*); Longhurst, 1958:32, 59 (as *Chthamalus rhizophorae* and *C. withersi*); Nilsson-Cantell, 1938a:177 (as *C. s. depressus*); Sandison, 1967: 166 (naupliar stages); Utinomi, 1968b:169.

DISTRIBUTION: West Africa.

*Euraphia apelloefi* (Nilsson-Cantell), 1921:292

SYNONYMY/DIAGNOSIS: Nilsson-Cantell, 1921:292.

REFERENCES: Hiro, 1936d:229; Kolosváry, 1941b:70; Nilsson-

- Cantell, 1926:1.  
 DISTRIBUTION: Java.  
*Euraphia calcareobasis* (Henry), 1957:30  
 REFERENCE: Newman, 1961:148.  
 DISTRIBUTION: Tuamoto Is.  
*Euraphia caudata* (Pilsbry), 1916:315  
 SYNONYMY/DIAGNOSIS: Pilsbry, 1916:315; Pope, 1965:35.  
 REFERENCES: Endean et al., 1956:88; Foster, 1974:42; Hiro, 1937b:51; Kolosváry, 1941b:70; Nilsson-Cantell, 1921:278, 296; 1930b:8; 1932d:3; Rosell, 1972:184; Stephenson et al., 1958:268; Zevina & Tarasov, 1963:84.  
 DISTRIBUTION: Australia; Philippines; Palau Is.; Indonesia.  
*Euraphia depressa* (Poli), 1791:27  
 SYNONYMY: Southward, 1964b:241.  
 DIAGNOSIS: Utinomi, 1959a:392.  
 REFERENCES: Barnes, 1956c:309 (biometry); Barnes & Barnes, 1964a:19 (exposure to air); 1964b:3 (distribution and ecology); 1968a:146 (variations in egg production); Barnes & Klepal, 1971:77 (pedicel of penis); Carli, 1966a:277 (mandible deformities); 1966b:115 (morphology and ecology); Darwin, 1854b:456; Gauld, 1957:10; Gruvel, 1905a:211; Hammel, 1972:435 (lactate oxidation); Huve & Huve, 1954:330 (zonation); Kolosváry, 1939c:169; 1941b:68; 1943:74; Monterosso, 1933:17 (morphology and biology); Nilsson-Cantell, 1938a:177; Pilsbry, 1916:17 (morphology and biology); Nilsson-Cantell, 1938a:177; Pilsbry, 1916:304; Ranzani, 1818:83 (as *Cthamalus glaber* n. sp.); Relini, 1964:402; 1969:170; Riedl, 1963:256; Stubbings, 1963a:7; Tenerelli, 1952:92 (biology); Utinomi, 1959a:382 (as *Cthamalus stellatus maxima*); Weltner, 1897:273.  
 DISTRIBUTION: Mediterranean: Gibraltar to Israel, Adriatic and Black Seas.
- Euraphia hembeli* Conrad, 1837:261  
 SYNONYMY: Henry, 1957:29.  
 DIAGNOSIS: Pilsbry, 1916:324; Newman, 1961:145.  
 REFERENCES: Darwin, 1854b:465; Gruvel, 1905a:205; Gordon, 1970:107; Kolosváry, 1941b:70; Kruger, 1911a:4; 1911b:460; Nilsson-Cantell, 1921:278, 290; Pilsbry, 1928:310; Weltner, 1897:272.  
 DISTRIBUTION: Hawaiian, Caroline, and Sunda Is.; Ceylon.
- Euraphia intertexta* (Darwin) 1854b:467  
 SYNONYMY/DIAGNOSIS: Pope, 1965:29.  
 REFERENCES: Foster, 1974:39; Gordon, 1970:110; Gruvel, 1905a:206; 1912a:349; Hiro, 1936d:227; 1939e:251; Hoek, 1913:269; Kolosváry, 1941b:70; Newman, 1961:143; Nilsson-Cantell, 1921:278; Pilsbry, 1916:324; 1928:310; Tokioka, 1953:123; Utinomi, 1949:21; 1954:22; 1968:169.  
 DISTRIBUTION: Indonesia north to Ryukyu and Tokara Is., eastward to Hawaii and Pitcairn I.
- Euraphia pilsbryi* (Hiro), 1936d:227  
 SYNONYMY/DIAGNOSIS: Hiro, 1936d:227.  
 REFERENCES: Hiro, 1937c:429; 1938c:1687 (resistance to exposure); Kolosváry, 1941b:70, 76 (forma *typica* and *neuseelandicus*); 1943a:77; Ooishi, 1964:195; Utinomi, 1949a:21; 1954:21; 1958b:51; 1969b:51; 1970:345; Utinomi & Kikuchi, 1966:5.  
 DISTRIBUTION: Southern Japan.
- Euraphia rhizophorae* (de Oliveira), 1940b:379  
 SYNONYMY/DIAGNOSIS: de Oliveira, 1941:26.  
 REFERENCES: Lacombe & Monteiro, 1974:633; Pope, 1965:40; Stubbings, 1963b:11.  
 DISTRIBUTION: Bahamas; Panama; Brazil.
- Euraphia withersi* (Pilsbry), 1916:312  
 SYNONYMY/DIAGNOSIS: Pope, 1965:39.  
 REFERENCES: Barnes & Klepal, 1971:77 (pedicel of penis); Broch, 1931; 131; Hiro, 1937b:49; Karande, 1967:1245 (fouling); Karande & Palekar, 1963b:130 (breeding); 1966:148; Kolosváry, 1941b:70; Longhurst, 1958:59, 85 (*C. aestuarii*); Morton, 1973:491; Nilsson-Cantell, 1921:295; 1930b:8; 1931a:107; 1938b:31; Rosell, 1972:182; 1973b:74; Stubbings, 1963b:11; 1967:259; Utinomi, 1968b:168; Zevina & Tarasov, 1963:83.  
 DISTRIBUTION: Mergui Arch.; Australia; Philippines; India; Madagascar.
- Subfamily Chthamalinae Darwin, 1854
- Genus *Cthamalus* Ranzani, 1817
- Cthamalus angustitergum* Pilsbry, 1916:305  
 SYNONYMY/DIAGNOSIS: Ross, 1968:2; Southward, 1975:20.  
 REFERENCES: Barnes & Klepal, 1971:77 (pedicel of penis); Henry, 1954:444; Kolosváry, 1939c:161; 1941b:68; Marshall, 1953:435 (as *C. stellatus*); Newell et al., 1959:209; Nilsson-Cantell, 1933:506; 1939a:3; Pilsbry, 1927:37; Smith et al., 1950:134; Stephensen & Stephensen, 1950:389 (as *C. stellatus*); 1954:80 (as *C. stellatus*); Voss & Voss, 1960:102 (as *C. stellatus*); Wells, 1966:92 (as *C. stellatus*); Werner, 1967:70 (as *C. stellatus*).  
 DISTRIBUTION: Caribbean.
- Cthamalus anisopoma* Pilsbry, 1916:317  
 SYNONYMY: Ross, 1962:8.  
 DIAGNOSIS: Pilsbry, 1916:317.  
 REFERENCES: Barnes & Barnes, 1965b:392 (variation in egg size); Henry, 1942:127; 1943:372; 1960:144; Kolosváry, 1941b:70; Nilsson-Cantell, 1921:276.  
 DISTRIBUTION: Gulf of California.
- Cthamalus antennatus* Darwin, 1854:460  
 SYNONYMY/DIAGNOSIS: Pope, 1965:45.  
 REFERENCES: Anderson, 1969:183 (embryology and phylogeny); Barnes & Klepal, 1971:77 (structure of the penis); Bennett & Pope, 1953:105; 1960:182; Broch, 1916:14; 1922:305; Dakin et al., 1948:176; Endean et al., 1956:88; Gruvel, 1903b:113; 1905a:203; 1911:292, 1912a:349; 1920:52; Guiler, 1952:20; Kolosváry, 1941b:70; Nilsson-Cantell, 1921:277, 285; 1926:10; 1927a:781; Pilsbry, 1916:296 (footnote); Pope, 1945:356; Rosell, 1972:174; 1973b:74; Utinomi, 1968b:170; Weltner, 1897:271; 1900:308; Wisely & Blick, 1964:163 (nauplii); Womersley & Edmonds, 1958:214 (ecology).  
 DISTRIBUTION: Australia; Tasmania.
- Cthamalus antiquus* Philippi, 1887:224  
 SYNONYMY: Ortmann, 1902:250 (? = *Balanus varians* Sowerby).  
 DISTRIBUTION: Miocene, Chile.
- Cthamalus belyaevi* Zevina & Kurshakova, 1973:187  
 DISTRIBUTION: Easter Is.; southeast Pacific.
- Cthamalus challengerii* Hoek, 1883:165  
 SYNONYMY: Hiro, 1932a:546.  
 DIAGNOSIS: Nilsson-Cantell, 1921:279.  
 REFERENCES: Barnes & Klepal, 1971:77 (pedicel of penis); Bhatt & Bal, 1960:439; Broch, 1927d:136; 1931:53 (as *C. challengerii* forma *krakatauensis* nov.); 1947:5; Gruvel, 1903b:113; 1905a:203; Hiro, 1932b:469; 1935c:215, 227; 1937c:429; 1938c:1687 (resistance to salinity and insolation); 1939a:128; 1939f:207; Kolosváry, 1941b:70; 1943a:75; Kruger, 1911a:46; 1911b:460; Luckens, 1968:75 (breeding and settlement); 1969:251 (breeding and settlement); 1970a:35 (predation and zonation); 1970b:161 (seasonal distribution); Nilsson-Cantell, 1921:279; 1925:23; 1927a:781; 1932b:8; 1932e:2; 1938b:31; Pilsbry, 1916:307; Pope, 1965:52; Tarasov & Zevina, 1957:256; Utinomi, 1949a:21; 1954:25; 1958b:51; 1962:215; 1969b:51; 1970:345; Utinomi & Kikuchi 1966:5; Weltner, 1897:272; Zevina & Litvinova, 1970:174; Zevina & Tarasov, 1963:79.  
 DISTRIBUTION: Japan; Bonin Is.; Philippines; Indonesia; Indian Ocean; Red Sea.
- Cthamalus challengerii krakatauensis* Broch, 1931:53  
 SYNONYMY: Hiro, 1939e:249 (= *C. moro* Pilsbry); Karande & Palekar, 1963a:231 (= *C. malayensis*).  
*Cthamalus challengerii nipponensis* Pilsbry, 1916:309  
 SYNONYMY: Nilsson-Cantell, 1921:279 (= *C. c. challengerii*).  

*Cthamalus cirratus* Darwin, 1854b:461  
 SYNONYMY/DIAGNOSIS: Pilsbry, 1916:321.  
 REFERENCES: Gruvel, 1903b:113; 1905a:202; 1912a:349; Kolosváry, 1941b:70; 1943a:75; Nilsson-Cantell, 1921:277; 1957:16; Pilshry, 1909:71; Weltner, 1897:272; 1898b:6; 1900:305; Zevina & Kurshakova, 1973:183.  
 DISTRIBUTION: Chile; Peru; Ecuador.

*Chthamalus dalli* Pilsbry, 1916:316

SYNONYMY: Cornwall, 1955b:23.

DIAGNOSIS: Pilsbry, 1916:316; Henry, 1940a:17.

REFERENCES: Barnes & Barnes, 1965a:392 (variation in egg size); Barnes & Gonor, 1958:194 (neurosecretory cells); Barnes & Klepal, 1971:77 (pedicel of penis); Cornwall, 1925:472; 1937:232; 1950:318; 1953:76 (nervous system); 1955a:36; Dayton, 1971:351 (community organization); Henry, 1942:121; Hiro, 1932b:469; 1935c:215; Kolosváry, 1941b:70; 1943a:76; Nilsson-Cantell, 1921:277; Rice, 1930:249 (distribution in communities); Southward & Southward, 1967:8 (biology); Stalcup, 1953:143; Tarasov & Zevina, 1957:256; Utinomi, 1970:345.

DISTRIBUTION: Unalaska to central California; northern Japan.

*Chthamalus dentatus* Krauss, 1848:135

SYNONYMY DIAGNOSIS: Stubblings, 1967:252.

REFERENCES: Barnard, 1924:97; Barnes & Barnes, 1965a:392 (variation in egg size); Barnes & Klepal, 1971:77 (structure of the penis); Broch, 1924b:202; Darwin, 1854b:463; Day & Morgans, 1956:303; Gauld, 1957:10; Gruvel, 1903b:113; 1905a:204; 1912a:345; Hoek, 1883:164; 1913:xvii; Kolosváry, 1941b:68; Millard, 1950:270; Millard & Broekhuysen, 1970:298; Nilsson-Cantell, 1921:277, 282; 1931a:107; 1938a:176; Ritz & Foster, 1968:553 (temperature response); Sandison, 1954:94; Stebbing, 1910:574; Stubblings, 1961b:19; 1961c:183; 1963b:13 1964b:333; 1965:885; Utinomi, 1968b:169; Weltner, 1897:272.

DISTRIBUTION: West coast of Africa as far north as Cape Verde Is., southeastern coast of Africa north to Madagascar and Mauritius.

*Chthamalus fissus* Darwin, 1854b:462

SYNONYMY: Ross, 1962:36.

DIAGNOSIS: Henry, 1942:121.

REFERENCES: Augenfeld, 1967:92 (metabolism); Barnes & Barnes, 1958a:550; 1959h:516 (metabolism); 1965a:392 (variation in egg size); Barnes & Klepal, 1971:77 (structure of the penis); Broch, 1922:308; Connell, 1970:49 (predation); Gruvel, 1903b:113; 1905a:202; Henry, 1943:368; 1960:144; Kolosváry, 1941b:71; 1943a:75; 1947e:361; 1951b:292; Nilsson-Cantell, 1921:276; Pilsbry, 1916:317; Weltner, 1897:273.

DISTRIBUTION: San Francisco, south into Gulf of California.

*Chthamalus fragilis* Darwin, 1854b:456

SYNONYMY DIAGNOSIS: Pilsbry, 1916:297; Stubblings, 1967:262; Southward, 1975:19.

REFERENCES: Barnes & Klepal, 1971:77 (pedicel of penis); Bousfield, 1954:123; Broch, 1927c:19; Crisp & Southward, 1961c:271 (cirral activity); Gordon, 1969:139 (influence of salinity); Gruvel, 1903b:113; Henry, 1954:444; Johnson, 1958:205 (fungal parasite in oval); Kolosváry, 1941b:68; 1943a:74; McDougall, 1943:351; Nilsson-Cantell, 1921:277; 1928a:30; 1933:505; 1939a:3; Pilsbry, 1927:37; Visscher, 1928a:327 (attachment); Visscher & Luce, 1928:336 (cyprid reaction to light); Wells, 1966:88; Weltner, 1897:273; Zullo, 1963b:8.

DISTRIBUTION: Cape Cod, Massachusetts south to West Indies; West Africa.

*Chthamalus imperatrix* Pilsbry, 1916:320

SYNONYMY DIAGNOSIS: Pilsbry, 1916:320.

REFERENCES: Kolosváry, 1941b:70; Nilsson-Cantell, 1921:276.

DISTRIBUTION: Panama.

*Chthamalus ligusticus* deAlessandri, 1895:306

SYNONYMY DIAGNOSIS: deAlessandri, 1906:283; Withers, 1953:61.

DISTRIBUTION: Pliocene, Italy.

*Chthamalus malayensis* Pilsbry, 1916:310

SYNONYMY: Utinomi, 1954:18; Karande & Palekar, 1963a:231; Pope, 1965:51.

DIAGNOSIS: Pope, 1965:51.

REFERENCES: Barnes & Klepal, 1971:77 (structure of the penis); Broch, 1916:14 (as *C. antennatus*); 1922:307 (as

*C. moro*); 1931:53 (as *C. challengerii* forma *krakatauensis*), 55, 56 (as *C. moro*); Daniel, 1955c:34 (as *C. stellatus stellatus*); Darwin, 1854b:455 (as *C. stellatus*); Endean et al, 1956:88 (ecology and distribution); 1956:317 (ecology and distribution); Foster, 1974:42; Gravel, 1912a:345 (as *C. antennatus*); Hiro, 1937b:49 (as *C. moro*); 1939e:249 (as *C. moro*), 250; Hoek, 1913:267 (as *C. stellatus*); Karande, 1966:148; 1967:1245 (fouling); Karande & Palekar, 1963a:231; 1963b:130 (breeding activity); Kolosváry, 1941b:70; 1943a:76; Kruger, 1914:435 (as *C. stellatus* var. *communis*); Nilsson-Cantell, 1921:277 (as *C. moro*); 279 (*C. challengerii* in part); 1934b:50 (*C. moro*); 1938b:30 (as *C. stellatus stellatus*), 31; Pilsbry, 1916:304 (as *C. stellatus stellatus*); 311 (*C. moro*); Stephenson et al, 1958:268 (insular ecology); Southward, 1964b:252; Stubblings, 1936:49 (as *C. stellatus*); 1961a:171; 1963a:328; Rosell, 1972:178 (questions synonymy of *C. moro* with *C. malayensis*); Utinomi, 1949a:25; 1968b:169; 1969:82; Zevina and Tarasov, 1963:80.

DISTRIBUTION: From Persian Gulf, India, Pakistan, Malay and South China Seas to Formosa; also Indonesia, Philippines, Palau Is.

*Chthamalus microtrethus* Cornwall, 1937:232

SYNONYMY DIAGNOSIS: Cornwall, 1951:319; Newman, 1975:269 (= *C. fissus*).

REFERENCE: Henry, 1942:127 (distribution list).

*Chthamalus panamensis* Pilsbry, 1916:319

SYNONYMY DIAGNOSIS: Pilsbry, 1916:319.

REFERENCES: Nilsson-Cantell, 1921:277; Kolosváry, 1941b:70.

DISTRIBUTION: Quarantine I., Panama.

*Chthamalus permitini* Zevini & Litvinova, 1970:178

DISTRIBUTION: Red Sea (possibly *C. malayensis*).

*Chthamalus scabrosus* Darwin, 1854b:468.

SYNONYMY: Nilsson-Cantell, 1921:278.

DIAGNOSIS: Pilsbry, 1916:323.

REFERENCES: Gravel, 1903b:113; 1905a:205; 1912a:349; Kolosváry, 1941b:70; 1943a:76; Nilsson-Cantell, 1957:6; Pilsbry, 1909:72; Weltner, 1895:291; 1897:272; 1898b:6; 1900:305; Zevina & Kurshakova, 1973:183.

DISTRIBUTION: Peru to Tierra del Fuego; Patagonia; Falkland Is.

*Chthamalus stellatus* (Poli), 1791:29

SYNONYMY: Southward, 1964b:241.

DIAGNOSIS: Southward, 1964b:247; Utinomi, 1959a:392.

REFERENCES: Annandale, 1906:149; Barnes, 1956b:355 (growth rate); 1956c:309 (biometry); Barnes & Barnes, 1958a:550 (self-fertilization); 1959h:515 (metabolism); 1964b:1 (distribution and ecology); 1965a:391 (variation in egg size); 1966a:83 (ecological and zoogeographical observations); 1966b:247 (recovery from severe winter); 1968a:135 (egg number and variation); 1969b:36 (seasonal changes in oxygen consumption); 1974:197 (embryonic development & salinity); Barnes & Crisp 1956d:631 (self-fertilization); Barnes et al, 1963f:233 (desiccation/anaerobic conditions); 1970:70 (resistance to impaction); 1971:173 (spermatozoa); 1972:89 (body weight and biochemical composition); Barnes & Klepal, 1971:77 (structure of the penis); Bassindale, 1936:57 (developmental stages); 1958:381; 1961:485; 1964:36; Bhatnagar & Crisp, 1965:419 (salinity tolerance of larvae); Bocquet-Védrine, 1956:2159 (tidal rhythm and growth); 1957:1545 (parasite of); 1958a:484 (parasite of); 1958b:2440 (parasite of); 1961:549 (parasite of); 1963:1350 (structure of the shell); 1965a:469 (parasite of); Bocquet & Ovechko, 1959:106 (salivary glands); Borradale, 1916:135; Broch, 1924b:203; 1927c:19; 1927d:136; Carli, 1966b:115; Caziot, 1921:54; Connell, 1957:1 (competition); 1961b:710 (competition); Crisp, 1950:311 (breeding and distribution); 1964a:208 (effect of severe winter); Crisp & Patel, 1958:1078 (breeding and ecdisis); Crisp & Southward, 1961:271 (cirral activity); Daniel, 1955a:97 (gregariousness); 1955c:34; 1957a:305 (effect of illumination); 1957b:866 (tidal influence); Darwin, 1854b:455; de Alessandri, 1895:304;

1906:283; Fischer, 1872:434; Fischer-Piette, 1955:37 (distribution); Fischer-Piette & Prenant, 1956:18; Fishelson, 1971:126; Foster, 1970:377 (response to salinity); 1971a:12 (desiccation); Groom, 1894:119 (early development); Gravel, 1905a:201; 1907d:5; 1912a:345; 1920:52; Hatton & Fischer-Piette, 1932:1 (settlement and growth); Hoek, 1875:58; 1909:272; 1913:267; Kitching, 1950:820; Klepal & Barnes, 1975:269 (ecology); Knight-Jones, 1953:583 (gregariousness); 1955:266 (gregariousness); Kolosváry, 1939a:178; 1941a:41; 1941b:68; 1943a:73; 1947a:31; Kruger, 1911a:45; 1911b:460; 1914:435; 1927a:13; 1927b:4; LeReste, 1965:53 (larvae); Monod, 1933:7; Monterosso, 1927-1932:(see bibliography); Moore, 1936:701 (biology); Moore & Kitching, 1939:521 (biology); Moyse, 1960:120 (rearing larvae); Moyse & Nelson-Smith, 1963:15 (zonation); Nilsson-Cantell, 1921:277, 281; 1931a:107; 1938b:30; 1939c:92; O'Riordan, 1967:291; Patel & Crisp, 1960a:667 (influence of temperature); 1960b:104 (rate of embryonic development); Petrone, 1969:539 (mouth parts); Pilsbry, 1916:302; Pope, 1965:24; Powell, 1954:688; Prenant & Teissier, 1923:172; Relini, 1964:397; Riedl, 1963:256; Rosell, 1972:172; 1973b:73; Southward, 1950:408; 1951:410; 1955b:403 (behavior); 1955c:423 (behavior); 1957:323 (behavior); 1962:162 (behavior); 1964a:391 (cirral activity and temperature); 1965:441 (metabolism and survival); Southward & Crisp, 1952:416 (distribution); 1954a:163 (distribution); 1956:211 (distribution); 1963:38 (fouling organisms); Stubbings, 1936:49; 1961b:18; 1963b:6; 1964a:107; 1965:885; 1967:251; Summer, 1909:373; 1911:128; Tarasov & Zevina, 1957:253; Tenerelli, 1952:122; 1958:263; 1959a:1 (fertilization); 1959b:14 (female sex apparatus); Utinomi, 1959a:381; Visscher, 1928b:193 (survival in freshwater); Weltner, 1895:291; 1897:272; 1898a:443; 1898b:9; Williams, 1950:311; Zevina, 1963:73.

**DISTRIBUTION:** British Isles; coasts of France, Portugal and Spain; Mediterranean and Black Seas; western coast of Africa to Cape Verde. Scattered records from Indo-Pacific need verification.

*Chthamalus stellatus bisinuatus* Pilsbry, 1916:306  
**SYNONYMY/DIAGNOSIS:** Pilsbry, 1916:306; de Oliveira, 1941:24; Southward, 1975:28.  
**REFERENCES:** Kolosváry, 1941b:68; Lacombe & Monteiro, 1974:633; Nilsson-Cantell, 1931a:107; Stubbings, 1961b:19; 1967:252; Wells, 1966:88.  
**DISTRIBUTION:** Rio de Janeiro and Santa Catarina Is., Brazil; Lagos, Nigeria; St. Andrews Bay, Florida.  
*Chthamalus stellatus eornutus* Nilsson-Cantell, 1925:25  
**DISTRIBUTION:** St. Vincent, Brazil; Isla de Flores, Uruguay.  
*Chthamalus stellatus thompsoni* Henry, 1958:220  
**DISTRIBUTION:** Bermuda.

#### Genus *Jehlius* Ross, 1971

*Jehlius gilmorei* Ross, 1971:271  
**DISTRIBUTION:** Islas San Ambrosio and San Felix, Chile (Zevina & Kurshakova, 1973:184).

#### Genus *Tetrachthamalus* Newman, 1967

*Tetrachthamalus obliteratus* Newman, 1967:425  
**REFERENCES:** Achituv, 1972:126 (zonation); Fishelson, 1971:113 (ecology); Morton, 1973:491; Southward, 1967:437 (ecology and cirral activity); Taylor, 1968:146 (ecology); Zevina & Litvinova, 1970:174.  
**DISTRIBUTION:** Gulfs of Aqaba and Suez; Seychelles; Mauritius; Aldabra.

#### Genus *Chamaesipho* Darwin, 1854

*Chamaesipho brunnea* Moore, 1944:320  
**SYNONYMY/DIAGNOSIS:** Moore, 1944:320.  
**REFERENCES:** Foster, 1967a:85; 1967b:33 (early stages); Luckens, 1970c:497 (breeding and settlement); Pope, 1965:63; Ritz and Foster, 1968:545 (comparative temperature responses).

**DISTRIBUTION:** New Zealand.

*Chamaesipho columnna* (Spengler), 1790:192

**SYNONYMY/DIAGNOSIS:** Moore, 1944:316.

**REFERENCES:** Anderson, 1969:183 (embryology); Barnes & Klepal, 1971:79 (structure of the penis); Broch, 1922:308; Bennett & Pope 1953:105; 1960:182; Dakin et al, 1948:176; Darwin, 1954b:470; Endean et al, 1956:88; Filhol, 1885:489; Foster, 1967a:84; 1967b:33 (early stages); Gravel, 1903b:159; 1905a:282; Guiler, 1952:20; Hutton, 1879:329; Jennings, 1918:63; Linzey, 1942a:280; Luckens, 1970c:497 (breeding and settlement); Moore, 1944:316; Nilsson-Cantell, 1926:11; Pope, 1945:357; Ritz and Foster, 1968:545 (comparative temperature responses); Weltner, 1897:273; 1899a:445; 1900:308; Wisely and Blick, 1964:162 (abundance of first stage nauplii); Womersley & Edmonds, 1958:232 (ecology).

**DISTRIBUTION:** Australia; New Zealand.

*Chamaesipho scutelliformis* Darwin, 1854b:472

**SYNONYMY/DIAGNOSIS:** Darwin, 1854b:472; Zevina & Tarasov, 1963:85.

**REFERENCES:** Gravel, 1903b:159; 1905a:283; Hoek, 1883:36; Kruger, 1911a:4; 1911b:461; Pope, 1965:64; Weltner, 1897:273.

**DISTRIBUTION:** South China Sea.

### Superfamily Balanomorphoidea n. superfam.

#### Family Coronulidae Leach, 1825

##### Subfamily Chelonibiinae Pilsbry, 1916

###### Genus *Chelonibia* Leach, 1817

*Chelonibia capellini* de Alessandri, 1895:300

**DISTRIBUTION:** Mio-Pliocene, Italy.

*Chelonibia caretta* (Spengler), 1790:185

**SYNONYM:** Pilsbry, 1916:267.

**DIAGNOSIS:** Darwin, 1854b:394.

**REFERENCES:** Barnard, 1924:93; Borradaile, 1903:443; Broch, 1924a:16; Daniel, 1955c:32; Dawyddoff, 1952:129; Gravel, 1905a:269; Hinks, 1840:333 (as *Balanus cheltrypetes*); Hiro, 1937b:69; Hoek, 1913:xvii; Kolosváry, 1943a:99; Korschelt, 1933:13; Mørch, 1852:67; Nilsson-Cantell, 1938b:14; Stubbings, 1967:297; Utinomi, 1969a:92; Wells, 1966:68; Weltner, 1897:254; Withers, 1928a:391; Zullo, 1963b:13.

**DISTRIBUTION:** Tropical Atlantic and Indo-West Pacific; Miocene, Zanzibar.

*Chelonibia depressa* Seguenza, 1876:411

**DISTRIBUTION:** Pliocene, Sicily.

*Chelonibia hemisphaerica* Rothpletz & Simonelli, 1890:724

**DISTRIBUTION:** Pliocene, Grand Canary I.

*Chelonibia manati* Gravel, 1903b:116

**SYNONYMY/DIAGNOSIS:** Stubbings, 1965:894.

**REFERENCES:** Broch, 1924b:203; Gravel, 1905a:267; Hiro, 1936a:61 (commensalism); Korschelt, 1933:17; Pilsbry, 1916:265; Stubbings, 1967:297; Utinomi, 1950:62.

**DISTRIBUTION:** West Africa; on skin of manatees.

*Chelonibia manati crenatibasis* Pilsbry, 1916:266

**DISTRIBUTION:** Unknown; probably from loggerhead turtle.

*Chelonibia manati lobatobasis* Pilsbry, 1916:266

**REFERENCES:** Henry, 1954:444; Kolosváry, 1942c:146; Wells, 1966:86.

**DISTRIBUTION:** Florida; on turtles.

*Chelonibia patula* (Ranzani), 1818:86

**SYNONYMY/DIAGNOSIS:** Pilsbry, 1916:268; Stubbings, 1967:297.

**REFERENCES:** Broch, 1924b:203; 1927d:136; 1935:2; 1947:7; Crisp & Costlow, 1963:22 (salinity tolerance); Daniel, 1955:32; Darwin, 1854b:396; Dawyddoff, 1952:129; Edmundson, 1933:231; Gauld, 1957:10; Gordon, 1970:90; Gravel, 1905a:268; 1907d:8; 1912a:346; Henry, 1954:444; Hiro, 1936a:60 (commensalism); Hoek, 1913:xvii; Kolosváry, 1943a:98; Korschelt, 1933:17; Kruger, 1911a:

4; 1911b:461; McDougall, 1943:343; Nilsson-Cantell, 1934b:61; 1938b:77; Pearse, 1947:327; 1952:7; Relini, 1969:169; Ross, 1963b:225; Ross & Jackson, 1972:203; Ross and Newman, 1967:18; Sandeen & Costlow, 1961: 192 (pigment activators); Southward & Crisp, 1963:26; Stubbings, 1961b:38; Utinomi, 1950:62; 1958a:309; Wells, 1966:86; Weltner, 1897:254; Williams & Porter, 1964: 150; Withers, 1929b:569; Zevina & Litvinova, 1970:174; Zullo, 1963b:14.

DISTRIBUTION: Tropical Atlantic to Indo-West Pacific. Miocene, Paris Basin.

*Chelonibia patula dentata* Henry, 1943:370

REFERENCE: Henry, 1960:147.

DISTRIBUTION: Sonora, Mexico; on crab.

*Chelonibia ramosa* Korschelt, 1933:2

REFERENCE: Hiro, 1936a:61 (commensalism).

*Chelonibia testudinaria* (Linnaeus), 1757:668

SYNONYMY: Nilsson-Cantell, 1921:369.

DIAGNOSIS: Nilsson-Cantell, 1921:369; Daniel, 1955c:31.

REFERENCES: Annadale, 1906:138; Barnard, 1924:92; Borradaile, 1903:443; Broch, 1916:14; 1924b:202; 1931: 122; 1947:7; Caziot, 1921:51; Darwin, 1854b:392; Dawyoff, 1952:129; de Alessandri, 1895:391; 1906:314; Edmondson & Ingram, 1939:258; Fischer, 1884:355; Gauld, 1957:10; Gordon, 1970:94; Gruvel, 1903b:115; 1905a:267; 1907d:8; Henry, 1941:105; 1943:371; 1954: 444; 1960:147; Hiro, 1936a:61 (commensalism); 1937b: 69; 1937c:470; 1939f:214; Hoek, 1913:xvii; Kolosváry, 1942c:149; 1943a:99; 1951c:411; 1967b:392; Korschelt, 1933:16; Krüger, 1911a:57; 1911b:461; Lanchester, 1902: 371; Linnaeus, 1767:1108; MacDonald, 1929:537; Morch, 1852:67; Newman et al, 1969:R289; Nilsson-Cantell, 1930b:19; 1931a:116; 1932d:258; 1938b:77; 1939a:5; 1957:7; Pillai, 1958:126 (larval stages); Pilsbry, 1916:264; 1928:316; Relini, 1969:169; Riedl, 1963:258; Ross, 1963b: 227; Ross and Newman, 1967:18; Stubbings, 1965:893; 1967:296; Utinomi, 1949a:24; 1958a:309; 1969a:92; 1969b:53; 1970:359; Utinomi & Kikuchi, 1966:8; Weltner, 1895:298; 1897:254; 1899a:443; 1910:528; Wells, 1966: 86; Zullo, 1963b:14.

DISTRIBUTION: All temperate and tropical seas, attached to turtles. Miocene, Cuba; Pliocene, Italy; Pleistocene, Florida.

*Chelonibia testudinaria solida* Withers, 1929b:568

SYNONYMY: Ross, 1963b:230.

REFERENCES: Ross & Newman, 1967:19.

DISTRIBUTION: Mio-Pliocene, France; Pleistocene, Florida.

### Subfamily Emersoniinae Ross, 1967

Genus *Emersonius* Ross, 1967

*Emersonius cybosyrinx* Ross, in Ross & Newman, 1967c:8

REFERENCE: Newman et al, 1969:R290.

DISTRIBUTION: Upper Eocene, Florida.

### Subfamily Platylepadinae n. subfam.

Genus *Platylepas* Gray, 1825

*Platylepas decorata* Darwin, 1854b:429

SYNONYMY/DIAGNOSIS: Nilsson-Cantell, 1921:376.

REFERENCES: Gruvel, 1905a:276; 1912a:350; Hiro, 1936a:61 (commensalism); 1936e:319; 1937b:70; Korschelt, 1933:22; Nilsson-Cantell, 1921:376; Utinomi, 1970:363; Weltner, 1897:253.

DISTRIBUTION: Galapagos, through Pacific Oceania to western coast of Australia; on turtles and sea snakes.

*Platylepas hexastylos* (Fabricius), 1798:35

SYNONYMY: Pilsbry, 1916:285.

DIAGNOSIS: Pilsbry, 1916:285; Hiro, 1937c:472 (mouthparts).

REFERENCES: Barnes & Klepal, 1971:89 (pedicel of penis); Broch, 1924a:18; 1924b:203; 1927c:30; Daniel, 1955c:33; Darwin, 1854b:428 (as *P. bissexlobata*); Fischer, 1884: 359; Gruvel, 1903b:151; 1905a:276; Henry, 1954:444; Hiro, 1936a:62 (commensalism); 1936e:319; Kolosváry, 1943a:101; 1951c:412; Korschelt, 1933:22; Krüger, 1912: 13; Relini, 1969:169; Richards, 1930:143; Schwartz, 1960:116; Stubbings, 1965:899; 1967:300; Utinomi, 1950: 62; 1959a:384; Weltner, 1897:253; Zullo, 1963b:15.

DISTRIBUTION: All tropical and sub-tropical seas; on turtles, manatees, dugongs.

*Platylepas hexastylos ichthyophila* Pilsbry, 1916:287

REFERENCE: Ryder, 1879:453 (as *P. decorata*).

DISTRIBUTION: On garfish; Florida.

*Platylepas indicus* Daniel, 1958b:755

DISTRIBUTION: Madras, India; on sea snakes.

*Platylepas kruegeri* (Krüger), 1912:12

SYNONYMY: Ross, 1963a:153.

DISTRIBUTION: Thailand.

*Platylepas multidecorata* Daniel, 1962b:641

DISTRIBUTION: Little Andaman I.; on green turtle.

*Platylepas ophiophilus* Lanchester, 1902:371

SYNONYMY/DIAGNOSIS: Utinomi, 1970:360.

REFERENCES: Broch, 1931:122; Darwin, 1854b:430; Gruvel, 1905a:277; Hiro, 1936a:61 (commensalism); 1936e:319; Korschelt, 1933:22; Krüger, 1912:12; Nilsson-Cantell, 1921:376; 1938b:77; Pilsbry, 1916:285; (renames *Cryptolepas ophiophilus* Kruger as *Platylepas kruegeri*).

DISTRIBUTION: Sea of Japan; Indonesia; western Australia; India; Arabian Sea; on sea snakes.

*Platylepas wilsoni* Ross, 1963a:153

DISTRIBUTION: Pleistocene, Florida.

### Genus *Stomatolepas* Pilsbry, 1910

*Stomatolepas elegans* (Costa), 1838:17

SYNONYMY: Hiro, 1937c:473.

DIAGNOSIS: Pilsbry, 1916:289; Hiro, 1936e:314 (includes *S. praegustator* Pilsbry 1916:289 and questionably *S. transversa* Nilsson-Cantell, 1930a:2).

REFERENCES: Henry, 1954:444; Hiro, 1936a:61 (commensalism); Holthuis, 1969:44; Nilsson-Cantell, 1930b: 20; Pilsbry, 1910:304; Relini, 1968a:223; 1969:169; Stubbings, 1965:902; 1967:300; Utinomi, 1970:363; Wells, 1966:87; Zullo & Bleakney, 1966:162.

DISTRIBUTION: Cosmopolitan; soft skin and throat of sea turtles.

### Genus *Cylindrolepas* Pilsbry, 1916

*Cylindrolepas darwiniana* Pilsbry, 1916:288

REFERENCE: Hiro, 1936e:319.

DISTRIBUTION: West Indies; in skin of sea turtle.

### Genus *Stephanolepas* Fischer, 1886

*Stephanolepas muricata* Fischer, 1886:193

SYNONYMY/DIAGNOSIS: Nilsson-Cantell, 1932d:258.

REFERENCES: Broch, 1947:7; Dawyoff, 1952:128; Gruvel, 1903b:151; 1905a:280; Hiro, 1936a:61 (commensalism); 1936e:318; Hoek, 1913:xvii; Nilsson-Cantell, 1938b:14; Weltner, 1897:253.

DISTRIBUTION: South China Sea; Ceylon; in skin of turtle.

### Subfamily Coronulinae Leach, 1817

Genus *Coronula* Lamarck, 1802

*Coronula aotea* Fleming, 1959:243

- SYNONYMY/DIAGNOSIS: Beu, 1971:899.  
 DISTRIBUTION: Pliocene, New Zealand.  
*Coronula barbara* Darwin, 1854a:38.  
 SYNONYMY/DIAGNOSIS: Darwin, 1854b:421.  
 REFERENCES: Beu, 1971:900; Darwin, 1854a:38; de Alessandri, 1895:303; 1906:317; Menesini, 1968a:395; Weisbord, 1971:91; Withers, 153:63; Zullo, 1969a:21.  
 DISTRIBUTION: Pliocene and early Pleistocene of Europe; Pliocene, Southern California.  
*Coronula bifida* Bronn, 1831:126.  
 SYNONYMY/DIAGNOSIS: Darwin, 1854b:423.  
 REFERENCES: de Alessandri, 1895:302; 1906:315; Menesini, 1968a:390; 1968b:584; Seguenza, 1876:324; Weisbord, 1971:94; Withers, 1953:63.  
 DISTRIBUTION: Tertiary, Italy.  
*Coronula diadema* (Linnaeus), 1767:1108.  
 SYNONYMY: Pilsbry, 1916:273 (contains pre-Darwinian references).  
 DIAGNOSIS: Pilsbry, 1916:273; Cornwall, 1924a:421.  
 REFERENCES: Barnard, 1924:94; Barnes & Klepal, 1971:88 (pedicel of penis); Bassindale, 1964:43; Beu, 1971:902 (Pliocene, New Zealand); Borradale, 1916:135; Broch, 1924a:91; Cornwall, 1927a:504; 1953:83 (nervous system); 1955a:51; 1955b:40; Crisp & Stubbings, 1957:179 (orientation to water currents); Darwin, 1854b:417; Filhol, 1885:489; Fischer, 1872:433; Fleming, 1959:246 (fossil); Gruvel, 1903b:152; 1905a:273; 1905b:308 (anatomy); Guiler, 1956:3; Hatai, 1938:98; 1939a:262; Hayasaka, 1933:49; 1935:1; Henry, 1943:368; Hiro, 1935c:226; 1936e:318; 1937c:471; 1939f:214; Hoek, 1883:163; 1909:271; Hutton, 1879:329; Jennings, 1918:62; Kolosváry, 1942a:138; 1942c:149; 1943a:99; 1967b:393; Korschelt, 1933:18; Mörch, 1852:66; Newman & Ross, 1971:179; Newman et al., 1969:R289; Nilsson-Cantell, 1921:371; 1930c:256; 1930d:212; 1931a:116; 1938b:14; 1939b:237; 1957:7; O'Riordan, 1967:294; Pilsbry, 1916:273 (= *Lepas balaenaris* Müller; *Balanus balaena* Da Costa; *Diadema vulgaris* Schumacher; *Diadema candidum* Ranzani; *Polydias kleinii* Gray; *Coronula biscayensis* Van Beneden; *Diadema japonica* Van Beneden; *D. californica* Van Beneden); Pilsbry & Olson, 1951:203 (= *Diadema antequum* Philippi 1887:226); Scheffer, 1939:67; Stubbings, 1910:571; Stephensen, 1938:6; Tarasov & Zevina, 1957:241; Weisbord, 1971:94; Weltner, 1895:290; 1897:254; 1898b:8; 1899b:102; 1900:302; 1922:86; Wolff, 1960:8; Zullo, 1963b:14.  
 DISTRIBUTION: Cosmopolitan, on Humpback, Fin, Blue and Sperm whales. Pliocene to Recent.  
*Coronula dormitor* Pilsbry & Olson, 1951:202.  
 DISTRIBUTION: Pliocene, Ecuador.  
*Coronula ficarazzensis* Gregorio, 1895:5.  
 DISTRIBUTION: Pleistocene, Italy.  
*Coronula macrotayi* Weisbord, 1971:91.  
 DISTRIBUTION: Pliocene, Venezuela.  
*Coronula reginae* Darwin, 1854b:419.  
 SYNONYMY: Tarasov & Zevina, 1957:244.  
 DIAGNOSIS: Cornwall, 1955b:43.  
 REFERENCES: Barnard, 1924:94; Barnes & Klepal, 1971:88 (structure of the penis); Broch, 1924a:93; Cornwall, 1927a:507; 1955a:54; Gruvel, 1903b:152; 1905a:272; Hiro, 1936e:318; Kolosváry, 1942a:140; 1942c:141; 1943a:99; 1967b:393; Krüger, 1927a:15; 1927b:5; Newman & Ross, 1971:178; Nilsson-Cantell, 1926:15; 1939b:238; 1957:8; Petroni, 1969:539 (comparison of mouth parts); Pilsbry, 1916:275; Stephensen, 1938:7; Weltner, 1897:254; 1898b:11; Wolff, 1960:8; Zullo, 1963b:14.  
 DISTRIBUTION: Atlantic and Pacific Oceans; on Humpback Whales.
- Genus *Cetopirus* Ranzani, 1817
- Cetopirus complanatus* (Mörch), 1852:67.  
 SYNONYMY/DIAGNOSIS: Pilsbry, 1916:276.  
 REFERENCES: Barnard, 1924:95; Broch, 1924b:204; Cornwall, 1953:83 (nervous system); Darwin, 1854b:415 (as
- Coronula balaenaris*); Gruvel, 1903b:152; 1905a:271; Guiler, 1956:3; Hiro, 1936e:318; Kolosváry, 1942a:141; 1943a:100; Murray, 1895:449; Newman et al., 1969:R289; Nilsson-Cantell, 1931a:116; 1938b:14; Stebbing, 1910:572 (as *Coronula darwini*); Stubbings, 1967:300; Tarasov & Zevina, 1957:245; Weisbord, 1971:94; Weltner, 1897:254; 1898b:8; 1900:307; Zullo, 1961a:13.  
 DISTRIBUTION: Chile; Cape of Good Hope; Australia; Tasmania; Kerguelen I., coast of Norway; Kei Is.
- Genus *Cetolepas* Zullo, 1969
- Cetolepas hertleini* Zullo, 1969a:17.  
 DISTRIBUTION: Pliocene, San Diego.
- Genus *Cryptolepas* Dall, 1872
- Cryptolepas murata* Zullo, 1961a:14.  
 DISTRIBUTION: Pleistocene, San Quintin Bay, Baja California.
- Cryptolepas rhachianecti* Dall, 1872:300.  
 SYNONYMY/DIAGNOSIS: Pilsbry, 1916:279.  
 REFERENCES: Briggs & Morejohn, 1972:287; Cornwall, 1955a:49 (soft parts); 1955b:44; Gruvel, 1903b:153; 1905a:274; Hiro, 1935c:227; 1936a:62 (commensalism); 1936e:318; Hoek, 1883:7; Kasuya & Rice, 1970:42 (orientation on whales); Kolosváry, 1943a:101; Korschelt, 1933:21; Scammon, 1874:22; Tarasov & Zevina, 1957:246; Weltner, 1897:278; Zullo, 1961a:13.  
 DISTRIBUTION: Bering Sea to Lower California; Korea; Hawaiian Is.; on Grey whales.
- Genus *Tubicina* Lamarck, 1802
- Tubicina* *major* Lamarck, 1802:463.  
 SYNONYMY: Nilsson-Cantell, 1921:373 (includes pre-Darwinian authors).  
 DIAGNOSIS: Darwin, 1854b:431.  
 REFERENCES: Barnard, 1924:95 (as *Tubicina* *striata* Lamarck); Gruvel, 1903b:148 (as *T. trachealis* Darwin); 1905a:278; 1909a:225; Hiro, 1936a:62 (commensalism); 1936e:318; Hutton, 1879:330 (as *T. trachealis*); Kolosváry, 1943a:100; Marloth, 1902:1 (mode of growth); Mörch, 1852:66; Nilsson-Cantell, 1931a:116; 1957:8; Pilsbry, 1916:281; Stebbing, 1902:62 (as *T. trachealis*); 1910:573 (as *T. striata*); Weltner, 1897:253 (as *T. trachealis*); 1898b:7; 1900:307; Zullo, 1963b:15.  
 DISTRIBUTION: Southern Atlantic and Pacific Oceans; on Southern Right Whales.
- Genus *Xenobalanus* Steenstrup, 1851
- Xenobalanus globicipitis* Steenstrup, 1851:pl. 3, figs. 11-15; 1852:64.  
 SYNONYMY/DIAGNOSIS: Cornwall, 1927a:510; Stubbings, 1965:902 (mouthparts).  
 REFERENCES: Barnard, 1924:96; Barnes & Klepal, 1971:88 (pedicel of penis); Bassindale, 1964:43; Broch, 1924a:95; Calman, 1920:165; Cornwall, 1955a:56; 1955b:46; Darwin, 1854b:440; Dollfus, 1968:55; Gruvel, 1903b:159; 1905a:280; 1920:55; Heldt, 1950:25; Hiro, 1936a:62 (commensalism); 1936e:318; Hoek, 1909:271; Kolosváry, 1943a:100; Krüger, 1911a:59; Newman & Ross, 1971:180; Nilsson-Cantell, 1921:375; 1930c:258; Pillerai, 1970:248; Pilsbry, 1916:283; Pope, 1958:159; Richard, 1936:55; Richard & Neuville, 1897:108; Stebbing, 1923:12 (as *X. natalensis*); Stubbings, 1967:301; Tarasov & Zevina, 1957:250; Weltner, 1897:253; 1898b:11; Zullo, 1963b:15.  
 DISTRIBUTION: World-wide; on porpoise, dolphin, and Black Fish.
- Family Bathylasmatidae Newman and Ross, 1971  
 Subfamily Bathylasmatinae n. status
- Genus *Bathylasma* Newman and Ross, 1971
- Bathylasma aucklandicum* (Hector), 1887:440.  
 SYNONYMY/DIAGNOSIS: Newman & Ross, 1971:151.  
 REFERENCES: Benham, 1903:111; Clarke, 1905:419; Park, 1910:113; Utinomi, 1965:11; Withers, 1913:841; 1924:18;

1953:357.

DISTRIBUTION: Miocene, New Zealand.

*Bathylasma corolliforme* (Hoek), 1883:155

SYNONYMY/DIAGNOSIS: Newman & Ross, 1971:143.

REFERENCES: Bage, 1938:1; Borradaile, 1916:132 (as *Hexelasma antarcticum* n. sp.); Gruvel, 1903b:143; 1905a:255; Hoek, 1913:245; Kruger, 1911a:55 (see *Aaptolasma callistoderma*); 1911b:460; Murray, 1895:421, 456; Nilsson-Cantell, 1930c:252; Pilsbry, 1916:330; Southward & Southward, 1958:635; Speden, 1962:746; Weisbord, 1965:1015 (in part); 1967:51 (in part); Weltner, 1897:271; 1900:305; Withers, 1924:22; Utinomi, 1965:13; Zevina, 1968:93.

DISTRIBUTION: Circum-Antarctic; to 1464m. Pleistocene, to 70m above sea level.

*Bathylasma hirsutum* (Hoek), 1883:158

SYNONYMY/DIAGNOSIS: Newman & Ross, 1971:149.

REFERENCES: Crisp & Southward, 1961:271 (cirral activity); Gruvel, 1903b:143; 1905a:256; 1920:55; Hoek, 1912:408; 1913:245; Jeffreys, 1878:414; Murray, 1895:456; Nilsson-Cantell, 1930c:252 (footnote 1); Pilsbry, 1916:330; Southward, 1957:323 (cirral activity); Southward & Southward, 1958:635; Utinomi, 1965:11; Weltner, 1897:271; 1898b:12.

DISTRIBUTION: Northeast Atlantic from Faeroe Is. south to Azores; 944-1829m.

#### Genus *Tessarelasma* Withers, 1936

*Tessarelasma pilosbyi* Withers, 1936:591

REFERENCE: Newman & Ross, 1971:155.

DISTRIBUTION: Miocene, Pakistan.

#### Genus *Tetrachaelasma* Newman and Ross, 1971

*Tetrachaelasma southwardi* Newman & Ross, 1971:152

SYNONYMY/DIAGNOSIS: Newman & Ross, 1971:152.

REFERENCES: Borradaile, 1916:132 (in part); Weisbord, 1965:1015 (in part); 1967:51 (in part).

DISTRIBUTION: Antarctic Basin and off S. America; 1190-2328m.

#### Subfamily Hexelasmidae n. subfam.

##### Genus *Hexelasma* Hoek, 1913

*Hexelasma arafurae* Hoek, 1913:251

SYNONYMY/DIAGNOSIS: Hoek, 1913:251.

REFERENCES: Newman & Ross, 1971:155; Utinomi, 1965:11.

DISTRIBUTION: Arafura Sea; 560m.

*Hexelasma fosteri* Newman & Ross, 1971:155

DISTRIBUTION: New Zealand; 538-676m.

*Hexelasma velutinum* Hoek, 1913:246

SYNONYMY: Utinomi, 1968a:30.

DIAGNOSIS: Hoek, 1913:246.

REFERENCES: Broch, 1931:53 (see *Aaptolasma leptoderma*); Hiro, 1933:70; Newman & Ross, 1971:155; Withers, 1913:847.

DISTRIBUTION: Japan; Philippines to South China Sea; 204-390m.

##### Genus *Aaptolasma* Newman and Ross, 1971

*Aaptolasma americanum* (Pilsbry), 1916:330

SYNONYMY/DIAGNOSIS: Newman & Ross, 1971:161.

REFERENCE: Utinomi, 1965:12.

DISTRIBUTION: Blake plateau, off Florida; 734-770m.

*Aaptolasma brintoni* Newman & Ross, 1971:162

SYNONYMY/DIAGNOSIS: Newman & Ross, 1971:162.

DISTRIBUTION: Off DaNang, Vietnam; 110-198m.

*Aaptolasma callistoderma* (Pilsbry), 1911:78

SYNONYMY/DIAGNOSIS: Newman & Ross, 1971:159.

REFERENCES: Hoek, 1913:245; Kruger, 1911a:55 (as *Balanus coralliformis*); 1911b:460; Pilsbry, 1916:332; Utinomi, 1958a:307; 1965:12.

DISTRIBUTION: Japan; 115-141m.

*Aaptolasma leptoderma* Newman & Ross, 1971:165

SYNONYMY/DIAGNOSIS: Newman & Ross, 1971:165.

REFERENCES: Broch, 1931:53 (as *Hexelasma velutinum*, in part).

DISTRIBUTION: Kei Is.; 290m.

*Aaptolasma triderma* Newman & Ross, 1971:164

SYNONYMY/DIAGNOSIS: Newman & Ross, 1971:164.

DISTRIBUTION: Japan; 549m.

#### Family Tetraclitidae Gruvel, 1903

##### Subfamily Austrobalaninae n. subfam.

###### Genus *Austrobalanus* Pilsbry, 1916

*Austrobalanus imperator* (Darwin), 1854b:288

SYNONYMY/DIAGNOSIS: Pope, 1945:364; Ross, 1971b:266 (as *Balanus (Austrobalanus) imperator*).

REFERENCES: Barnes & Klepal, 1971:86 (pedicel of penis); Dakin et al, 1948:176; Davadie, 1963:78; Endean et al, 1956:88 (ecology and distribution); Gruvel, 1905a:246; Kolosváry, 1942c:140; 1943a:92; Kruger, 1940:466; Pilsbry, 1916:219; Pope, 1959:117; Weltner, 1897:271; Wisely & Blick, 1964:163 (nauplii).

DISTRIBUTION: Australia.

###### Genus *Epopella* Ross 1970

*Epopella breviscutum* (Broch), 1922:337

SYNONYMY/DIAGNOSIS: Ross, 1970:3.

REFERENCE: Hiro, 1939e:275.

DISTRIBUTION: Auckland Is.

*Epopella plicatus* (Gray), 1843:269

SYNONYMY/DIAGNOSIS: Moore, 1944:326 (includes *Elminius rugosus* Hutton 1879:328); Ross, 1970:9 (ex *Elminius*).

REFERENCES: Barnes & Klepal, 1971:87 (pedicel of penis); Broch, 1922:341; Darwin, 1854b:351; Filhol, 1885:489; Foster, 1967b:35 (larval stages); Gruvel, 1903b:163; 1905a:296, 297; 1906a:270; 1907d:1; 1909b:26; Jennings, 1918:62; Kolosváry, 1942c:140; Krüger, 1940:470; Luckens, 1970c:497 (breeding and growth); Nilsson-Cantell, 1930d:211; Pilsbry, 1916:261; Ritz & Foster, 1968:552 (temperature); Weltner, 1897:256; 1899a:443; 1900:307.

DISTRIBUTION: Australia; New Zealand; Chatham, Snares and Auckland Is.

*Epopella simplex* (Darwin), 1854b:353

SYNONYMY/DIAGNOSIS: Pope, 1945:370; Ross, 1970:9 (ex *Elminius*).

REFERENCES: Barnes & Klepal, 1971c:87 (structure of the penis); Broch, 1922:342; Dakin et al, 1948:176; Gruvel, 1903b:163; 1905a:297; 1912a:350; 1909b:6; Guiler, 1952:20; Kolosváry, 1942c:140; Krüger, 1914:429; 1940:470; Linzey, 1942a:280; Moore, 1944:333; Nilsson-Cantell, 1938b:13; Pope, 1966:181; Weltner, 1897:256; 1900:307.

DISTRIBUTION: Australia; Tasmania; Kermadec Is.

#### Subfamily Tetraclitellinae n. subfam.

##### Genus *Tetraclitella* Hiro, 1939

*Tetraclitella chinensis* (Nilsson-Cantell), 1921:359

SYNONYMY: Utinomi, 1970:347.

DIAGNOSIS: Nilsson-Cantell, 1921:359.

REFERENCES: Hiro, 1931:155 (as *Tetraclita purpurascens nipponensis* n. subsp.); 1932b:473; 1937c:469; 1939e:273; Ross, 1971a:217, 223; Utinomi, 1949a:36; 1954:23; Utinomi and Kikuchi, 1966:8; Zevina & Tarasov, 1963:97.

DISTRIBUTION: Southern Japan; China; Formosa.

*Tetraclitella costata* (Darwin), 1854b:339

SYNONYMY/DIAGNOSIS: Darwin, 1854b:339; Nilsson-Cantell, 1930b:19.

REFERENCES: Gordon, 1970:98; Gruvel, 1905a:287; Hiro, 1916:259; 1928:316; Ross, 1971a:217, 233; Weltner, 1898:257.

DISTRIBUTION: Philippines; Indonesia.

*Tetraclitella costata digita* Rosell, 1975:97

DISTRIBUTION: Philippines.

*Tetraclitella darwini* (Pilsbry), 1928:314

SYNONYMY: Utinomi, 1970:348.

DIAGNOSIS: Pilsbry, 1928:314.

REFERENCES: Hiro, 1937c:469; 1939e:277; 1939f:214; Kolosváry, 1943a:98; Nilsson-Cantell, 1931a:115; Ross, 1971a:217, 223; Utinomi, 1949a:24; 1958a:304; 1962:237; 1969b:53; Utinomi &amp; Kikuchi, 1966:8.

DISTRIBUTION: Japan; Formosa.

*Tetraclitella divisa* (Nilsson-Cantell), 1921:362

SYNONYMY: Ross, 1968:13.

DIAGNOSIS: Stubbings, 1967:291.

REFERENCES: Bassindale, 1961:485; Edmondson, 1933:231 (as *T. purpurascens*); Foster, 1974:45; Hiro, 1939e:275; Pilsbry, 1928:316; Ross, 1961:210; 1968:13. (as *T. d. subquadra* n. subsp.); 1971a:217, 223; Utinomi, 1949a:25; Zevina & Tarasov, 1963:96.

DISTRIBUTION: Caribbean; West Africa; Sumatra; Formosa; South China Sea; Pacific Oceania to Hawaii and Pitcairn.

*Tetraclitella hyastina* Rosell, 1974:7

DISTRIBUTION: Mindanao, Philippines.

*Tetraclitella karandei* Ross, 1971a:217

REFERENCES: Ross, 1972:307; Karande, 1974a:249 (larvae).

DISTRIBUTION: Bombay coast, India; Taiwan.

*Tetraclitella multicostata* (Nilsson-Cantell), 1930a:2.

SYNONYMY/DIAGNOSIS: Utinomi, 1962:231.

REFERENCES: Foster, 1974:46; Nilsson-Cantell, 1930b:18; Ross, 1971a:217, 223.

DISTRIBUTION: New Guinea; Fiji; Japan.

*Tetraclitella pilsbryi* (Utinomi), 1962:234

SYNONYMY/DIAGNOSIS: Utinomi, 1962:234.

REFERENCES: Ross, 1971a:217, 223; Utinomi &amp; Kikuchi, 1966:8; 1970:348.

DISTRIBUTION: Southern Japan.

*Tetraclitella purpurascens* (Wood), 1815:55

SYNONYMY: Nilsson-Cantell, 1921:358.

DIAGNOSIS: Pope, 1945:367.

REFERENCES: Anderson, 1969:183 (embryology and phylogeny); Barnes & Klepal, 1971:87 (pedicel of penis); Bhatt and Bal, 1960:440; Broch, 1931:117; Dakin et al, 1948:176; Daniel, 1955c:30; Darwin, 1854b:337; Dawyodoff, 1952:128; Endean et al, 1956:88 (ecology and distribution); Filhol, 1885:488; Foster, 1967a:83; 1967b:35 (larvae); Gauld, 1957:10; Gordon, 1970:101; Gruvel, 1905a:285; Guiler, 1952:20; Hutton, 1879:328; Jennings, 1918:61; Karande, 1967:1245; 1966:147; Kolosváry, 1941a:42 (as *Tetraclita squamosa depressa*); 1942c:140 (as *Tetraclita purpurascens darwini*); 1943a:97 (var. *darwini*); 1941e:11 (as *Tetraclita radiata wagneri*); Krüger, 1911a:4; Linzey, 1942a:279; Luckens, 1970c:497 (distribution and growth); Moore, 1944:333; Nilsson-Cantell, 1931a:115; 1938b:13; Ritz & Foster, 1968:552 (temperature response); Ross, 1971a:217, 223; Stubbings, 1967:293; Weltner, 1897:258; 1899a:443; 1900:307; Wisely & Blick, 1964:163 (nauplii).

DISTRIBUTION: Australia; New Zealand; Indonesia; India; Madagascar; East Africa.

Genus *Newmanella* Ross, 1969*Newmanella radiata* (Bruguière), 1789:168

SYNONYMY/DIAGNOSIS: Ross, 1969:242

REFERENCES: de Blainville, 1824:378; 1825:598; 1827:plate 85; Bruguière, 1791:plate 164; Chemnitz, in Martini &amp; Chemnitz, 1785:343; Darwin, 1854b:343; Deshayes, 1831:357; Gmelin, 1791:3213; Gruvel, 1903b:161; 1905a:291; Hoek, 1913:xvi; Jay, 1839:7; Kolosváry, 1943a:97; Lamarck, 1818:393; Lamy &amp; Andre, 1932:218; Nilsson-Cantell, 1931a:115; 1939a:5; Pilsbry, 1916:259; 1927:38; 1953:27; Pope, 1945:368; Ranzani, 1818:75; 1820:39; Ross, 1968:18; Southward, 1962:163 (behavior of cirrus IV); Southward, 1975:17; Sowerby, 1823: (no pagination); Spengler, 1790:172; Weltner, 1897:258.

DISTRIBUTION: Florida through Caribbean to Venezuela.

## Subfamily Tetraclitinae Gruvel, 1903

Genus *Tesseropora* Pilsbry, 1916*Tesseropora isseli* (de Alessandri), 1895:296

DISTRIBUTION: Oligocene, Italy (Withers, 1953:59).

*Tesseropora pacifica* (Pilsbry), 1928:312SYNONYMY/DIAGNOSIS: Pilsbry, 1928:312 (as *T. wireni pacifica*); Henry, 1957:33.

REFERENCES: Foster, 1974:44; Gordon, 1970:103; Hiro, 1936a:59 (commensalism); Kolosváry, 1962c:193; 1967b:393; Ross, 1969:239.

DISTRIBUTION: Insular, Indo-West Pacific (Fiji to Hawaii).

*Tesseropora rosea* (Krauss), 1848:136

SYNONYMY: Pilsbry, 1916:260.

DIAGNOSIS: Pope, 1945:366.

REFERENCES: Anderson, 1969:183 (embryology/phylogeny); Barnard, 1924:92; Dakin et al, 1948:176; Darwin, 1854b:335; Endean et al, 1956:88 (ecology and distribution); Gruvel, 1903b:161; 1905a:286; Hoek, 1883:161; Kolosváry, 1943a:98; Linzey, 1942a:280; Moore, 1944:333; Nilsson-Cantell, 1927a:786; 1938b:14; Stebbing, 1910:571; Wisely &amp; Blick, 1964:163 (nauplii); Weltner, 1897:258.

DISTRIBUTION: Australia; Kermadec I.; South Africa.

*Tesseropora wireni* (Nilsson-Cantell), 1921:366

SYNONYMY/DIAGNOSIS: Hiro, 1937b:68.

REFERENCE: Hiro, 1936a:59 (commensalism).

DISTRIBUTION: Sumatra; Palau Is.

*Tesseropora wireni africana* (Nilsson-Cantell), 1932b:14

SYNONYMY/DIAGNOSIS: Nilsson-Cantell, 1932b:14.

REFERENCES: Nilsson-Cantell, 1938b:14; Smith, 1971:103.

DISTRIBUTION: Dar-es-Salaam and Diego Garcia, Indian Ocean.

Genus *Tesseroplax* Ross, 1969*Tesseroplax unisemita* (Zullo), 1968d:272

REFERENCE: Ross, 1969:237.

DISTRIBUTION: Pliocene, Isla Angel de la Guardia, Gulf of California.

Genus *Tetraclita* Schumacher, 1817*Tetraclita alba* Nilsson-Cantell, 1932b:11

REFERENCE: Nilsson-Cantell, 1938b:13.

DISTRIBUTION: Dar-es-Salaam.

*Tetraclita coerulescens* (Spengler), 1790:191

SYNONYMY: Nilsson-Cantell, 1938b:77.

DIAGNOSIS: Broch, 1931:116.

REFERENCES: Darwin, 1854b:342; Endean et al, 1956:88; Gruvel, 1905a:290; Hiro, 1936b:635; 1937b:67; 1939c:586; Hoek, 1883:161; 1913:257; Pilsbry, 1916:259; Rosell, 1972:211; Stephenson et al, 1958 (insular ecology); Weltner, 1897:257.

DISTRIBUTION: Philippines; Palau Is.; Sulu Arch.; Indonesia; Bay of Bengal; Mergui Arch.; Australia.

*Tetraclita dumortieri* Fischer, 1865:434

REFERENCE: de Alessandri, 1907:290.

DISTRIBUTION: Miocene, France.

*Tetraclita hentscheli* Kolosváry, 1942c:141

REFERENCE: Kolosváry, 1943a:98.

DISTRIBUTION: Puerto Cabello, Venezuela.

*Tetraclita serrata* Darwin, 1854b:334

SYNONYMY: Barnard, 1924:91.

DIAGNOSIS: Darwin, 1854b:334.

REFERENCES: Annandale, 1906:144; Barnes &amp; Barnes, 1965a:392 (variation in size); Day &amp; Morgans, 1956:270 (ecology); Gruvel, 1903b:161; 1905a:289; Hoek, 1913:254; Millard, 1950:270; Nilsson-Cantell, 1938b:13; Pichon, 1972:381; Ritz &amp; Foster, 1968:545 (temperature responses); Rosell, 1972:208; Sandison, 1954:96 (nauplii); Stebbing, 1910:570; Weltner, 1897:258.

DISTRIBUTION: South Africa; Madagascar; Ceylon; Philippines.

*Tetraclita squamosa squamosa* (Bruguière), 1789:170

SYNONYMY: Henry, 1957:33.

DIAGNOSIS: Pilsbry, 1916:251; Kruger, 1911a:61.

REFERENCES: Barnard, 1924:90; Borradaile, 1900:799; Broch, 1916:14; 1922:337; 1924b:204; 1931:116; 1947:7; Crisp & Southward, 1961:272 (cirral activity); Darwin, 1854b:329 (as *Tetraclita porosa* var. *viridis*); Dawyodoff, 1952:128; de Oliveira, 1941:6 (probably *T. stalactifera*); Endean et al, 1956:88 (mainland ecology and distribution); 1956:317 (insular ecology and distribution); Foster, 1974:45 (as *T. squamosa viridis*); Gruvel, 1896a:43 (branchiae); 1896b:205 (anatomy); 1896e:186 (review); 1905a:288; 1909a:216, 225; 1909b:25; Hiro, 1936b:635; 1937b:66; 1937c:467; 1939c:586; 1939e:271; Hoek, 1913:254; Kolosváry, 1943a:96; 1951c:412; Krüger, 1911b:461; 1914:441; 1940:472; Moore, 1944:333; Morton, 1973:491; Nilsson-Cantell, 1921:364; 1930b:17; 1931a:115; 1934a:71; 1934b:61; 1938b:76; Nomura, 1938:87; Ooishi, 1964:195; Pilsbry, 1916:249; Rosell, 1972:205; 1973b:94; Spengler, 1790:192 (? *Lepas mitra*); Stebbing, 1910:570 (*porosa* Gmelin, 1790 = *squamosa* Brugière, 1789); Stephenson et al, 1958 (insular ecology); Stubbings, 1967:284; Utinomi, 1942:10; 1949a:25; 1954:23; 1958a:304; 1968b:178; 1969b:53; Weltner, 1895:289 (probably *T. stalactifera*); 1897:257; 1910:528; Zevina & Litvinova, 1970:174; Zevina & Tarasov, 1963:95.

DISTRIBUTION: Japan; Formosa; Philippines; Palau Is.; Indonesia; Australia; Mergui Arch.; Andamans; Great Nicobar I.; Red Sea; Rio de Janeiro; Cape Palmas, W. Africa. Pliocene: Ryukyu I.

*Tetraclita squamosa formosana* Hiro, 1939e:271

SYNONYMY/DIAGNOSIS: Hiro, 1939e:271.

REFERENCES: Ooishi, 1964:195; Utinomi, 1949a:23; 1954:23; 1969b:53.

DISTRIBUTION: Southern Japan; Formosa.

*Tetraclita squamosa japonica* Pilsbry, 1916:252

SYNONYMY: Hiro, 1932a:551; 1937c:469.

DIAGNOSIS: Pilsbry, 1916:252.

REFERENCES: Hiro, 1932b:473; 1938c:1687 (resistance to exposure); 1939f:213; Ikenouye, 1968:99 (spatial distribution); Kolosváry, 1943a:96; Krüger, 1911a:61 (as *Tetraclita porosa* var. *nigrescens*); 1940:472; Mori, 1958:23 (rhythmic activity); 1961:373 (rhythmic activity); Nilsson-Cantell, 1927a:786; 1931a:115; 1932a:27; Pilsbry, 1911:81 (as *T. porosa*); Suzuki & Mori, 1963:1 (water content); Tarasov & Zevina, 1957:236; Utinomi, 1949a:23; 1958a:304; 1958b:51; 1969b:53; 1970:347; Utinomi & Kikuchi, 1966:6; Weltner, 1897:257 (as var. *nigrescens*); Zevina & Tarasov, 1963:95.

DISTRIBUTION: Japan and Korea.

*Tetraclita squamosa milleporosa* Pilsbry, 1916:257

SYNONYMY/DIAGNOSIS: Pilsbry, 1916:257

REFERENCES: Hedgpeth, 1969:9 (as *Tetraclita stalactifera milleporosa*); Zullo, 1966c:143.

DISTRIBUTION: Galapagos Is.

*Tetraclita squamosa panamensis* Pilsbry, 1916:256

SYNONYMY/DIAGNOSIS: Pilsbry, 1916:256.

REFERENCES: Hedgpeth, 1969:17; Kolosváry, 1943:97; Nilsson-Cantell, 1957:10; Pilsbry, 1909:64; Zevina & Kurshakova, 1973:183.

DISTRIBUTION: Panama; Ecuador; Peru; Galapagos Is.

*Tetraclita squamosa patellaris* Darwin, 1854b:330

SYNONYMY: Pilsbry, 1916:248.

DIAGNOSIS: Darwin, 1854b:330.

REFERENCES: Gruvel, 1903b:161; 1905a:288; 1907d:8; 1909b:25; Nilsson-Cantell, 1938b:13; Weltner, 1897:258.

DISTRIBUTION: Andaman Is.

*Tetraclita squamosa perfecta* Nilsson-Cantell, 1931a:133

DISTRIBUTION: Santuao, China.

*Tetraclita squamosa rubescens* Darwin, 1854b:329

SYNONYMY: Ross, 1962:34.

DIAGNOSIS: Cornwall, 1951:312.

REFERENCES: Barnes, 1959a:233 (stomach contents); Barnes & Barnes, 1959h:515 (metabolism); 1965a:392

(egg size); Barnes & Klepal, 1971:86 (pedicel of penis); Broch, 1922:337; Darwin, 1854b:330 (as *T. s. rubescens* forma *elegans* nov.); Emerson, 1956:339; Gruvel, 1903b:161; 1905a:288; 1909b:25 (including forma *elegans*); Henry, 1942:122, 123 (as *elegans*); 1960:147; Hewatt, 1935:250; 1946:199; Hoek, 1913:254; Kolosváry, 1943a:96; Krüger, 1940:472; Pilsbry, 1916:257, 258 (as *elegans*); Rasmussen, in Shelford et al, 1935:307; Shimkin et al, 1951:650 (carcinogenic substances); Weltner, 1897:257, 258 (as *T. porosa* var. 5. *elegans*); Willett, 1937:383; Zullo, 1966c:141 (as *T. squamosa elegans*).

DISTRIBUTION: Central California to Cape San Lucas, Baja California. Pleistocene: Los Angeles, California and Punta China, Baja California.

*Tetraclita squamosa rufotincta* Pilsbry, 1916:253

SYNONYMY: Utinomi, 1968b:180.

DIAGNOSIS: Pilsbry, 1916:253.

REFERENCES: Achituv, 1972:73 (zonation); Barnes & Klepal, 1971c:86 (pedicel of penis); Fishelson, 1971:123 (ecology and distribution in Red Sea); Kolosváry, 1943a:97; Krüger, 1940:472; Nilsson-Cantell, 1921:365; 1928a:35; 1938b:13; Utinomi, 1969a:82; Zevina & Litvinova, 1970:174.

DISTRIBUTION: Red Sea; East Africa; Arabian coast, west coast of India, and islands of the western Indian Ocean.

*Tetraclita stalactifera* (Lamarck), 1818:394

SYNONYMY/DIAGNOSIS: Ross, 1968:8.

REFERENCES: Barnes & Klepal, 1971:86 (pedicel of penis); Bigelow, 1902:180; Chenu, 1843:(no pagination); Cornwall, in Steinbeck & Ricketts, 1941:430; Darwin, 1854b:329 (as *Tetraclita porosa* var. 1. *communis* and var. 2. *nigrescens*); de Oliveira, 1940a:138; 1941:7; Gruvel, 1903b:161; 1905a:287; Henry, 1941:105; 1942:127; 1943:367; 1954:444; 1958:224; 1960:147; Kolosváry, 1943a:97; Krüger, 1911a:61 (*Tetraclita squamosa japonica* according to Pilsbry); 1911b:461 (*T. s. japonica*); 1940:472; Lacombe & Monteiro, 1974:633; Lamy & Andre, 1932:222; Morch, 1852:67; Newell et al, 1959:209; Nilsson-Cantell, 1933:508; 1939a:5; Pilsbry, 1916:254; 1927:38; Ross, 1962:32; Smith et al, 1950:134; Stephensen & Stephensen, 1950:388; 1952:8; Stubbings, 1936:49; Utinomi, 1968b:179; Verrill, 1901:22; Voss & Voss, 1960:102; Zullo, 1966c:141.

DISTRIBUTION: Bermuda; S.E. United States; Gulf of Mexico; West Indies to southern Brazil; Gulf of California to Acapulco, Mexico. Other localities: Arabian Sea (reported by Stubbings as *Tetraclita porosa* var. *communis*); Cape Province, S. Africa (reported by Utinomi as *Tetraclita squamosa stalactifera*). Plio-Pleistocene: Curaçao. Pleistocene: Venezuela.

*Tetraclita stalactifera confinis* Pilsbry, 1916:255

SYNONYMY: Ross, 1962:34.

DIAGNOSIS: Pilsbry, 1916:255.

REFERENCES: Barnes & Klepal, 1971:86 (pedicel of penis); Henry, 1941:105; 1943:369; 1960:143; Hertlein & Emerson, 1956:167.

DISTRIBUTION: Gulf of California. Pleistocene: Sonora, Mexico.

*Tetraclita stalactifera floridana* Pilsbry, 1916:255

REFERENCES: Barnes & Klepal, 1971:86 (pedicel of penis). DISTRIBUTION: Lake Worth Inlet, Florida.

*Tetraclita vitiata* Darwin, 1854b:340

SYNONYMY: Nilsson-Cantell, 1938b:76.

DIAGNOSIS: Broch, 1922:339

REFERENCES: Endean et al, 1956:88 (mainland ecology and distribution); 1956:317 (insular ecology and distribution); Gruvel, 1903b:161; 1905a:289; Hiro, 1936b:635; 1937b:67; 1939c:586; Hoek, 1913:256; Pilsbry, 1916:259; Rosell, 1972:214; Stephenson, 1968:51; Stephenson et al, 1958:261 (insular ecology); Weltner, 1897:258.

DISTRIBUTION: Philippines; Sulu Arch.; Indonesia; Great Barrier Reef, Australia; Nicobar I.

- Superfamily Balanoidea Leach, 1817 n. status  
 Family Archaeobalanidae n. fam.  
 Subfamily Archaeobalaninae n. subfam.
- Genus *Archaeobalanus* Menesini, 1971  
*Archaeobalanus semicanaliculatus* Menesini, 1971:28  
 REFERENCE: Plaziat & Cavelier, 1973:2875.  
 DISTRIBUTION: Eocene and Oligocene, Paris Basin.
- Genus *Actinobalanus* Moroni, 1967  
*Actinobalanus actinomorphus* (Moroni), 1952:73  
 SYNONYM: Moroni, 1967:923.  
 DIAGNOSIS: Moroni, 1952:73.  
 DISTRIBUTION: Pliocene, Italy.
- Actinobalanus bisculcatus* (Darwin), 1854a:26  
 SYNONYM: Ross & Newman, 1967:6.  
 DIAGNOSIS: Darwin, 1854b:293.  
 REFERENCES: Davadie, 1967:74; de Alessandri, 1907b:286; Moroni, 1967:925; Withers, 1953:58, 62.  
 DISTRIBUTION: Coralline Crag, England; Eocene-Pliocene, Northern Europe.
- Actinobalanus bisulcatus plicatus* (Darwin), 1854a:26  
 SYNONYM: Ross & Newman, 1967:6.  
 REFERENCE: Darwin, 1854b:293; Davadie, 1963:74.  
 DISTRIBUTION: Coralline Crag, England; Belgium.
- Actinobalanus pantanelli* (de Alessandri), 1895:293  
*Actinobalanus dolosus* (Darwin), 1954a:28  
 SYNONYM: Moroni, 1967:925.  
 DIAGNOSIS: Darwin, 1854b:295; Davadie, 1963:76; Kolosváry, 1967b:391; Lecointre, 1910:138.  
 DISTRIBUTION: Miocene, France; Pliocene, England and Norway.
- Actinobalanus inclusus* (Darwin), 1854a:31  
 SYNONYM: Moroni, 1967:925; Davadie, 1963:75; Kolosváry, 1967b:391.  
 DIAGNOSIS: Darwin, 1854b:299.  
 DISTRIBUTION: Miocene to Pleistocene, Northern Europe.  
 DISTRIBUTION: Pliocene, Italy.
- Actinobalanus stellaris* (Brocchi), 1814:599  
 SYNONYM: de Alessandri, 1906:302 (= *B. corrugatus* Darwin, 1854b:254); Davadie, 1963:66 (*B. s. var. miocenicus* Seguenza, 1876:453).  
 DISTRIBUTION: Oligocene-Pliocene, Italy.
- Genus *Kathpalmeria* Ross, 1965  
*Kathpalmeria georgiana* Ross, in Ross and Newman, 1965a:61  
 DISTRIBUTION: Eocene, Georgia.
- Kathpalmeria hantheni* (Kolosváry), 1947b:305  
 SYNONYM: Ross, 1965a:62.  
 DIAGNOSIS: Kolosváry, 1947b:305.  
 REFERENCE: Plaziat & Cavelier, 1973:2875 (as *Balanus (Austrobalanus) hantheni*).  
 DISTRIBUTION: Eocene, Hungary.
- Genus *Armatobalanus* Hoek, 1913  
*Armatobalanus (Armatobalanus) allium* (Darwin), 1854b:281  
 SYNONYM: Zullo, 1963d:588.  
 DIAGNOSIS: Utinomi, 1949a:30.  
 REFERENCES: Annandale, 1906:148; 1924:62 (as *Balanus arcuatus*); Broch, 1922:325, 333 (as *Acasta madreporicola* n. sp.); 1931:78 (as *Balanus arcuatus*); Gruvel, 1905a:247; Hiro, 1936a:38 (as *Acasta madreporicola*); Hoek, 1913:210 (as *Balanus arcuatus* n. sp.); Kolosváry, 1951a:288; Nilsson-Cantell, 1921:337 (as *Balanus arcuatus*); 1938b:52 (as *Balanus arcuatus*); Pilsbry, 1916:228; Utinomi, 1949a:32 (*Balanus arcuatus* and *Acasta madreporicola*, discussion); 1962:217; Utinomi & Kikuchi, 1966:6; Weltner, 1897:271; Zullo, 1967b:126.  
 DISTRIBUTION: Great Barrier Reef; Indonesia; Southwest Japan; Ceylon; Bay of Bengal; 9-55m.
- Armatobalanus (Armatobalanus) allium truncatus* (Utinomi), 1949a:32  
 SYNONYMY/DIAGNOSIS: Utinomi, 1949a:32.  
 REFERENCE: Zullo, 1963d:588.  
 DISTRIBUTION: Tanabe Bay, Japan.
- Armatobalanus (Armatobalanus) calvertensis* (Ross), 1965:334  
 DISTRIBUTION: Miocene, Maryland.
- Armatobalanus (Armatobalanus) cepa* (Darwin), 1854b:283  
 SYNONYMY: Nilsson-Cantell, 1938b:52.  
 DIAGNOSIS: Nilsson-Cantell, 1938b:52.  
 REFERENCES: Borradale, 1903:442 (as *?Balanus terebratus*); Broch, 1931:79; Gruvel, 1905a:251; Hiro, 1936b:625 (as *Balanus fujiyama*); Kolosváry, 1943a:93 (as *Balanus fujiyama*); 1947e:358 (as *Balanus fujiyamaformis* n. sp.); Nilsson-Cantell, 1932c:6; Pilsbry, 1916:228; Utinomi, 1949a:29; Zullo, 1963d:589.  
 DISTRIBUTION: Indonesia; Australia; Mergui Arch.; Maldives; southwest Japan; 50m.
- Armatobalanus (Armatobalanus) circe* (Kolosváry), 1947e:359  
 SYNONYMY/DIAGNOSIS: Kolosváry, 1947e:359.  
 REFERENCES: Kolosváry, 1951a:288; Ross, 1965b:332; Zullo, 1963d:589.  
 DISTRIBUTION: West Indies.
- Armatobalanus (Armatobalanus) duvergieri* (de Alessandri), 1922:223  
 DIAGNOSIS/REFERENCES: Withers, 1929a:562; 1953:57; 58; Zullo, 1961b:71.  
 DISTRIBUTION: Miocene, France; on *Porites incrassata*.
- Armatobalanus (Armatobalanus) filigranus* (Broch) 1916:8  
 SYNONYMY/DIAGNOSIS: Broch, 1916:8.  
 REFERENCES: Hiro, 1937b:56; Zullo, 1963d:(errata).  
 DISTRIBUTION: W. Australia; Palau ls.; 4-20m.
- Armatobalanus (Armatobalanus) funicularum* (Annandale), 1906:145  
 SYNONYMY/DIAGNOSIS: Annandale, 1906:145.  
 REFERENCES: Kolosváry, 1951b:229; Zullo, 1963d:589.  
 DISTRIBUTION: Gulf of Manaar.
- Armatobalanus (Armatobalanus) nefrens* (Zullo), 1963d:590  
 SYNONYMY/DIAGNOSIS: Zullo, 1963d:590.  
 REFERENCE: Ross, 1965b:332.  
 DISTRIBUTION: Monterey and Carmel Bays and Channel Is., California.
- Armatobalanus (Armatobalanus) oryza* Broch, 1931:82  
 SYNONYMY/DIAGNOSIS: Broch, 1931:82.  
 REFERENCE: Zullo, 1963d:589.  
 DISTRIBUTION: Banda Sea; 200m.
- Armatobalanus (Armatobalanus) palaoensis* Hiro, 1937b:60  
 SYNONYMY/DIAGNOSIS: Hiro, 1937b:60.  
 REFERENCE: Zullo, 1963d:589.  
 DISTRIBUTION: Palau ls.
- Armatobalanus (Armatobalanus) quadrivittatus* Darwin, 1854b:284  
 SYNONYMY: Zullo, 1963d:589.  
 DIAGNOSIS: Hoek, 1913:213.  
 REFERENCES: Borradale, 1903:442; Broch, 1947:8; Davadie, 1952:30; Dawyoff, 1952:128; Gruvel, 1903b:141; 1905a:248; Hoek, 1907:xvi; Kolosváry, 1947d:425; 1951b:292; Nilsson-Cantell, 1921:339; 1934b:60; 1938b:54; Pilsbry, 1916:229; Utinomi, 1962:217; Utinomi & Kikuchi, 1966:6; Weltner, 1897:271.  
 DISTRIBUTION: Maldives; Indonesia; Singapore; Viet Nam; Mergui Arch.; Southwestern Japan; Philippines; 31-51m. Miocene, Algeria.
- Armatobalanus (Armatobalanus) quinquevittatus* Hoek, 1913:216  
 SYNONYMY/DIAGNOSIS: Hoek, 1913:216.  
 REFERENCE: Zullo, 1963d:589.  
 DISTRIBUTION: Off Amboin; 32m.
- Armatobalanus (Armatobalanus) terebratus* Darwin, 1854b:285  
 SYNONYMY: Nilsson-Cantell, 1938b:51.  
 DIAGNOSIS: Hoek, 1913:207.  
 REFERENCES: Annandale, 1906:148; Borradale, 1903:442; Broch, 1916:6; Dawyoff, 1952:128; Gruvel, 1905a:249;

- Hiro, 1935a:1; 1937b:55; Korschelt, 1933:27; Weltner, 1897:271; Zullo, 1963d:590.
- DISTRIBUTION: Palau Is.; Kei Is.; western Australia; Gulf of Siam; Madras, India; 0-55m.
- Armatobalanus (Armatobalanus) terebratus radicifer* (Annandale), 1924:63
- SYNONYMY/DIAGNOSIS: Annandale, 1924:63.
- REFERENCES: Hiro, 1937b:55; Zullo, 1963d:590.
- DISTRIBUTION: Mergui Arch.
- Subgenus *Hexacreusia* Zullo, 1961
- Armatobalanus (Hexacreusia) durhami* (Zullo), 1961b:73
- SYNONYMY/DIAGNOSIS: Zullo, 1961b:73.
- REFERENCES: Newman & Ladd, 1974:383; Ross, 1962:37; Ross & Newman, 1973:148; Zullo, 1967b:126; Zullo & Beach, 1973:13; Zullo et al, 1972:72.
- DISTRIBUTION: Pliocene to Recent: Gulf of California, on *Porites*.
- Armatobalanus (Hexacreusia) straeleni* (Zullo & Beach), 1973:11
- DISTRIBUTION: Galapagos, on ahermatypic coral; 55-90m.
- Genus *Chirona* Gray, 1835
- Chirona (Chirona) bimanicus* (Withers), 1923:288
- DISTRIBUTION: Miocene, Burma.
- Chirona (Chirona) evermanni* (Pilsbry), 1907d:203
- SYNONYMY: Tarasov & Zevina, 1957:230 (includes *B. (Metabalanus) hoekianus* Pilsbry, 1911:77).
- DIAGNOSIS: Pilsbry, 1916:201 (as *Balanus hoekianus*); Pilsbry, 1916:210.
- REFERENCES: Barnes & Klepal, 1971:85 (pedicel of penis); Henry, 1942:126; Hiro, 1935c:227; Hoek, 1913:151, 246 (as *Hexelasma hoekianum*); Kruger, 1911b:460; Newman & Ross, 1971:171; Pilsbry, 1911:76 (*evermanni*, 77 (*hoekianus*)).
- DISTRIBUTION: Gulf of Alaska; Aleutians and Bering Sea; 140-490m.
- Chirona (Chirona) hameri* (Ascanius), 1767:8
- SYNONYMY: Pilsbry, 1916:205.
- DIAGNOSIS: Pilsbry, 1916:205.
- REFERENCES: Barnes & Barnes, 1965a:391 (variation in egg size); Barnes & Klepal, 1971:85 (pedicel of penis); Bas-sindale, 1964:39; Bousfield, 1954:121; Broch, 1924a:88; Crisp, 1962b:123 (larval stages); Crisp & Southward, 1961:271 (cirral activity); Darwin, 1854a:24; 1854b:277; Davadie, 1963:71; Foster, 1970:377 (acclimation to salinity); Gravel, 1903b:141; 1905a:245; Hoek, 1875:60; 1909:270; Kolosváry, 1967b:392; Krüger, 1927a:14; 1927b:5; 1940:464; Moore, 1935a:57 (growth rate); Mørch, 1852:68; O'Riordan, 1967:293; Poulsen, 1935:16; Rzhepishevskii, 1968:36; Southward & Crisp, 1963:32 ( fouling); Stephensen, 1938:6; Tarasov, 1937:52; Walker, 1970:239 (cement apparatus); 1972:429 (cement composition); 1973b:455 (frontal horns and gland cells); Weltner, 1897:270; 1898a:443; 1898b:12; Zullo, 1963b:13.
- DISTRIBUTION: North Atlantic; Chesapeake Bay; Barents and North Seas; England; 29-305m. Plio-Pleistocene, Northern Europe and North America.
- Chirona (Chirona) sublaevis* (Sowerby), 1840:327
- REFERENCES: Withers, 1923:285.
- DISTRIBUTION: Soomrow, India.
- Chirona (Chirona) unguiformis* (Sowerby), 1846:pl. 648
- SYNONYMY: Darwin, 1854a:29.
- REFERENCES: Darwin, 1854b:296; Davadie, 1963:73 (thin sections); de Alessandri, 1907b:288; Plaziat & Cavalier, 1973:2875 (paleo-ecology); Ross & Newman, 1967:4; Withers, 1953:48 et seq.
- DISTRIBUTION: Eocene-Oligocene, England and Paris Basin. Eocene, Southeastern U.S.
- Chirona (Chirona) varians* (Sowerby), 1846:pl. 2
- REFERENCES: Darwin, 1854b:298; 1897:622; Ortmann, 1902:250 (probably includes *Chthamalus antiquus* (Phillippi)); Withers, 1953:141.
- DISTRIBUTION: Tertiary, Patagonia and Tierra del Fuego.

- Subgenus *Striatobalanus* Hoek, 1913
- Chirona (Striatobalanus) amaryllis* (Darwin), 1854b:279
- SYNONYMY/DIAGNOSIS: Darwin, 1854b:279; Hoek, 1913:179.
- REFERENCES: Annandale, 1906:147; Barnes & Klepal, 1971:85 (pedicel of penis); Broch, 1916:6; 1922:321 (as forma *euamarillys* nov.); 1931:66, 67 (as forma *laevis* nov.); 1947:5, 6; Daniel, 1955:25; Darwin, 1854b:279 [var. a (= *Balanus roseus* Lamarck, 1818); var. b.]; Dawyodoff, 1952:128; Endean et al, 1956:88; Gruvel, 1903b:141; 1905a:250 (as var. *niveus* nov. = var. b.); Darwin, 1854b; Hiro, 1936b:624; 1939d:243; Hoek, 1883:153; 1912:408; 1913:179; Karande, 1967:1245; Karande & Palekar, 1966:147; Kruger, 1911a:4; 1911b:460; 1940:464; Lanchester, 1902:369 (as *Balanus amaryllis dissimilis* n. subsp.); Nilsson-Cantell, 1921:329; 1927a:785; 1930b:10; 1931a:114; 1934a:68; 1934b:58; 1938b:46; Pope, 1945:364; Stubbings, 1936:41; 1961a:174; Utinomi, 1962:216; 1968b:174; 1969a:88; Utinomi & Kikuchi, 1966:6; Weltner, 1897:270.
- DISTRIBUTION: Indo-west Pacific; East Africa to Philippines and Northeast Australia; 5-500m., and on ships.
- Chirona (Striatobalanus) bimae* (Hoek), 1913:182
- SYNONYMY/DIAGNOSIS: Hoek, 1913:182.
- REFERENCES: Broch, 1931:70; Nilsson-Cantell, 1934b:58; 1938b:48.
- DISTRIBUTION: Java Sea; 12-35m.
- Chirona (Striatobalanus) krugeri* (Pilsbry), 1916:214
- SYNONYMY/DIAGNOSIS: Pilsbry, 1916:214.
- REFERENCES: Broch, 1931:71; Hiro, 1933:72; 1937c:440; 1939b:56; Utinomi, 1949b:96; 1958a:308.
- DISTRIBUTION: Japan; Moluccas; 100-250m.
- Chirona (Striatobalanus) maculatus* (Hoek), 1913:187
- DISTRIBUTION: Java Sea.
- Chirona (Striatobalanus) taiwanensis* (Hiro), 1939e:264
- DISTRIBUTION: Formosa.
- Chirona (Striatobalanus) tenuis* (Hoek), 1883:154.
- SYNONYMY: Hiro, 1937c:439.
- DIAGNOSIS: Hoek, 1913:185 (as *Balanus albus* n.sp.).
- REFERENCES: Barnard, 1924:74; Broch, 1931:70; Daniel, 1955:24; Gruvel, 1905a:247; Hoek, 1912:408; Nilsson-Cantell, 1925:34; 1927a:785; 1938b:46; Pilsbry, 1916:216; Stubbings, 1936:41 (as *albus*); 1940:390; Utinomi, 1950:63; 1962:216; 1968b:174; 1969a:88; Utinomi and Kikuchi, 1966:6; Weltner, 1897:271.
- DISTRIBUTION: Indo-west pacific; South Africa, Persian Gulf to Philippines and Japan; 7-500m.
- Chirona (Striatobalanus) tuberculatus* (Rosell), 1974:2
- DISTRIBUTION: Mindanao, Philippines.
- Chirona (Striatobalanus) zealandicus* (Withers), 1924:35
- DISTRIBUTION: Miocene, New Zealand (Withers, 1953:78 et seq.).
- Genus *Solidobalanus* Hoek, 1913
- Solidobalanus (Solidobalanus) astacophilus* (Barnard), 1926:128
- SYNONYMY/DIAGNOSIS: Barnard, 1926:128.
- REFERENCES: Henry & McLaughlin, 1967:47; Zullo & Newman, 1964:368.
- DISTRIBUTION: South Africa; 420m.
- Solidobalanus (Solidobalanus) auricoma* (Hoek), 1913:198
- SYNONYMY: Zullo & Newman, 1964:368.
- DIAGNOSIS: Hoek, 1913:198; Nilsson-Cantell, 1938b:49.
- REFERENCES: Broch, 1922:323; 1931:71; Henry & McLaughlin, 1967:46; Nilsson-Cantell, 1934a:70; Utinomi, 1969:82.
- DISTRIBUTION: Persian Gulf; Moluccas; southwest Australia; 27-320m.
- Solidobalanus (Solidobalanus) ciliatus* (Hoek), 1913:199.
- SYNONYMY: Zullo & Newman, 1964:368.
- DIAGNOSIS: Hoek, 1913:199; Nilsson-Cantell, 1934a:68.
- REFERENCES: Annandale, 1906:148 (as *Balanus maldivensis* Borradale, 1903); Broch, 1931:72; 1947:6; Dawyodoff, 1952:128; Henry & McLaughlin, 1967:47; Nilsson-Cantell, 1925:38; 1934b:59; 1938b:49; Stubbings, 1936:43; Utinomi, 1969a:90.

- DISTRIBUTION: Indo-west Pacific: Gulfs of Aden, Persia and Manaar; Red Sea; India; Indonesia; 13-220m.
- Solidobalanus (Solidobalanus) compressus* (Hoek), 1913:202  
REFERENCES: Henry & McLaughlin, 1967:47; Zullo & Newman, 1964:369.
- DISTRIBUTION: Banda Sea; 75-112m.
- Solidobalanus (Solidobalanus) echinoplacis* (Stubbings), 1936:45  
REFERENCES: Henry & McLaughlin, 1967:47; Zullo & Newman, 1964:369.
- DISTRIBUTION: Zanzibar; 225m.
- Solidobalanus (Solidobalanus) hawaiiensis* (Pilsbry), 1916:222  
REFERENCES: Gordon, 1970:81; Henry & McLaughlin, 1967:47 (*hawaiensis* [sic]); Utinomi, 1949b:96; Zullo & Newman, 1964:369.
- DISTRIBUTION: Hawaian Is.; 21-222m.
- Solidobalanus (Solidobalanus) maldivensis* (Borradaile), 1903:442  
SYNONYMY/DIAGNOSIS: Hoek, 1913:195.  
REFERENCES: Annandale, 1906:148; Henry & McLaughlin, 1967:47; Zullo & Newman, 1964:369.
- DISTRIBUTION: Maldives and Flores Sea; 69-390m.
- Solidobalanus (Solidobalanus) masignotus* (Henry & McLaughlin), 1967:47  
REFERENCE: McLaughlin & Henry, 1972:14 (complemental males).
- DISTRIBUTION: Central Baja California; Mazatlan, Mexico; Costa Rica; Ecuador; sublittoral.
- Solidobalanus (Solidobalanus) mylensis* (Seguenza), 1876:308  
SYNONYMY: Moroni, 1967:5 (milensis of some authors); Withers, 1953:61,62.
- DISTRIBUTION: Neogene, Italy.
- Solidobalanus (Solidobalanus) nascanus* (Zullo, in Zullo & Newman), 1964:366  
REFERENCES: Henry & McLaughlin, 1967:47; Zevina & Kurshakova, 1973:183.
- DISTRIBUTION: Eastern Pacific: Nasca Ridge; 228m.
- Solidobalanus (Solidobalanus) pseudauricoma* (Broch), 1931:72  
SYNONYMY/DIAGNOSIS: Utinomi, 1949b:97.  
REFERENCES: Henry & McLaughlin, 1967:47; Zullo & Newman, 1964:369.
- DISTRIBUTION: Celebes; Japan; 70-500m.
- Solidobalanus (Solidobalanus) socialis* (Hoek), 1883:150  
SYNONYMY: Zullo & Newman, 1964:369.  
DIAGNOSIS: Hoek, 1883:150; 1913:192.  
REFERENCES: Annandale, 1906:148 (as *Balanus aeneas*); Gruvel, 1905a:226,252 (as *Balanus aeneas*); Henry & McLaughlin, 1967:46; Hiro, 1932b:473; 1937c:442; Hoek, 1913:150,154 (as *Balanus aeneas*); Lanchester, 1902:370 (as *Balanus aeneas* n.sp.); Stubbings, 1963a:334; Utinomi, 1949a:22; 1962:217; 1968b:175; 1969a:89; 1970:359; Utinomi & Kikuchi, 1966:6; Weltner, 1897:267.
- DISTRIBUTION: Indo-west Pacific: Gulfs of Persia and Manaar; Bay of Bengal; Indonesia; Southeast coast of Japan; to 91m.
- Solidobalanus (Solidobalanus) solidus* (Broch), 1931:76  
REFERENCES: Henry & McLaughlin, 1967:47; Zullo & Newman, 1964:369.
- DISTRIBUTION: Japan; 300m.
- Solidobalanus (Solidobalanus) tantillus* (Pilsbry), 1916:224  
REFERENCES: Henry & McLaughlin, 1967:47; Zullo & Newman, 1964:369.
- DISTRIBUTION: Sulu Arch.; 100m.
- Solidobalanus (Solidobalanus) thompsoni* (Stubbings), 1936:43  
REFERENCES: Henry & McLaughlin, 1967:47; Nilsson-Cantell, 1938b:13; Zullo & Newman, 1964:369.
- DISTRIBUTION: Gulf of Aden; 73-220m.
- Subgenus *Hesperibalanus* Pilsbry, 1916
- Solidobalanus (Hesperibalanus) cornwalli* (Zullo) 1966a:200  
DISTRIBUTION: Eocene, Washington.
- Solidobalanus (Hesperibalanus) elizabethae* (Barnard) 1924:72  
SYNONYMY/DIAGNOSIS: Millard, 1950:267.  
REFERENCES: Nilsson-Cantell, 1932c:8 (as *Balanus emkeniensis* n.sp.); Henry & McLaughlin, 1967:47.
- DISTRIBUTION: South Africa.
- Solidobalanus (Hesperibalanus) engbergi* (Pilsbry), 1921:113  
SYNONYMY: Cornwall, 1955b:31.  
DIAGNOSIS: Pilsbry, 1921:113.  
REFERENCES: Barnes & Klepal, 1971:84 (pedicel of penis); Cornwall, 1955a:31; Henry, 1940:33; 1942:107; Henry & McLaughlin, 1967:47; Tarasov & Zevina, 1957:227; Zullo, 1969b:351.
- DISTRIBUTION: Alaska to Oregon; 28-80m. Pleistocene, Oregon.
- Solidobalanus (Hesperibalanus) fallax* (Broch), 1927:26  
SYNONYMY/DIAGNOSIS: Stubbings, 1963b:30.  
REFERENCES: Barnes & Klepal, 1971:86 (pedicel of Penis); Bassindale, 1961:485; Henry & McLaughlin, 1967:47; Nilsson-Cantell, 1939c:93; Stubbings, 1961b:34 (as *Balanus (Solidobalanus) occidentalis* n.sp.); 1961c:189 (as *occidentalis*); 1963:30; 1965:892; 1967:287; Utinomi, 1959b:402.
- DISTRIBUTION: Algeria and West Africa; 7-220m.
- Solidobalanus (Hesperibalanus) hesperius hesperius* (Pilsbry), 1916:193  
SYNONYMY/DIAGNOSIS: Pilsbry, 1916:193.  
REFERENCES: Barnes & Barnes, 1959d:237 (naupliar stages); 1965a:391 (size variation); Barnes & Klepal, 1971:85 (pedicel of penis); Broch, 1922:321; Cornwall, 1955b:35; Henry, 1942:127; Henry & McLaughlin, 1967:47; Hiro, 1935c:225; 1939f:212; Kolosváry, 1943a:92; Krüger, 1940:464; Tarasov & Zevina, 1957:228; Utinomi, 1970:359; Zullo, 1969b:351.
- DISTRIBUTION: North Pacific: Japan; Bering Sea; Alaska; British Columbia; 60-180m. Pleistocene, Oregon.
- Solidobalanus (Hesperibalanus) hesperius laevidomiformis* (Kolosváry), 1941e:9  
REFERENCES: Barnes & Klepal, 1971:85 (pedicel of penis); Kolosváry, 1943a:92; Henry & McLaughlin, 1967:47 (as *incertae sedis*)
- DISTRIBUTION: Panama.
- Solidobalanus (Hesperibalanus) hesperius laevidomus* (Pilsbry), 1916:196  
SYNONYMY/DIAGNOSIS: Henry, 1940:31.  
REFERENCES: Barnes & Gonor, 1958:194 (neurosecretory cells); Cornwall, 1955a:34; 1955b:35; Henry, 1942:110; Henry & McLaughlin, 1967:47; Hiro, 1935c:227; Kolosváry, 1943a:92; Newman, 1975:269; Nilsson-Cantell, 1927a:785; Pilsbry, 1921:113; Tarasov & Zevina, 1957:228.
- DISTRIBUTION: Alaska to San Francisco; 8-338m.
- Solidobalanus (Hesperibalanus) hesperius nippensis* (Pilsbry), 1916:199  
SYNONYMY/DIAGNOSIS: Pilsbry, 1916:199.  
REFERENCES: Henry & McLaughlin, 1967:47; Tarasov & Zevina, 1957:228; Utinomi, 1958a:308.
- DISTRIBUTION: Pacific coast of Japan; 50m.
- Solidobalanus (Hesperibalanus) parahesperius* (Menesini), 1971:22  
REFERENCE: Plaziat & Cavelier, 1973:2875 (paleo-ecology).  
DISTRIBUTION: Eocene and Oligocene, Paris Basin.
- Solidobalanus (Hesperibalanus) phineus* (Kolosváry), 1956:187  
DISTRIBUTION: Eocene, Hungary.
- Solidobalanus (Hesperibalanus) proinus* (Woodring, in Woodring & Bramlette), 1950:92  
SYNONYMY: Zullo, 1969a:16.  
DISTRIBUTION: Pliocene, Southern California.
- Solidobalanus (Hesperibalanus) sookensis* (Cornwall), 1927b:400  
DISTRIBUTION: Miocene, Vancouver I., Canada.
- Solidobalanus (Hesperibalanus) stenorotus* (Pilsbry & Olson), 1951:201  
DISTRIBUTION: Oligocene, Ecuador.

*Solidobalanus (Hesperibalanus) varians* (Sowerby), 1846:pl. 2  
 REFERENCES: Chapman, 1914:54,67; Darwin, 1854b:298; Ortmann, 1902:250.  
 DISTRIBUTION: Eocene, Patagonia.

*Solidobalanus (Hesperibalanus) vialovi* (Kolosváry), 1961c:150  
 DISTRIBUTION: Eocene, USSR.

#### Subgenus *Bathybalanus* Hoek, 1913

*Solidobalanus (Bathybalanus) pentacrini* (Hoek), 1913:230  
 SYNONYMY/DIAGNOSIS: Hoek, 1913:230.  
 REFERENCES: Hiro, 1936a:59; Newman & Ross, 1971:173.  
 DISTRIBUTION: Banda Sea; 240-304m.

#### Genus *Notobalanus* n.gen

*Notobalanus flosculus* (Darwin), 1854b:290

SYNONYMY/DIAGNOSIS: Pilsbry, 1916:219.

REFERENCES: Gruvel, 1905a:252; Kolosváry, 1943a:93; Korschelt, 1933:27; Krüger, 1940:466; Nilsson-Cantell, 1957:21; Weltner, 1895:291; 1897:271; Zevina & Kurshakova, 1973:183.

DISTRIBUTION: Peru; Chile; Tierra del Fuego.

*Notobalanus flosculus* var. *sordidus* (Darwin), 1854b:290  
 SYNONYMY/DIAGNOSIS: Nilsson-Cantell, 1921:330.

REFERENCES: Davadie, 1952:30; Fletcher, 1938:115; Gruvel, 1903b:141; 1905a:252; 1905b:345; Kolosváry, 1943a:93; Newman & Ross, 1971:169; Nilsson-Cantell, 1957:21; Weltner, 1895:291; 1897:271; 1898b:5; 1900:305.

DISTRIBUTION: Chile to Tierra del Fuego. Miocene. Algeria. Late Cenozoic, Kerguelan I.

*Notobalanus vestitus* (Darwin), 1854:286

SYNONYMY/DIAGNOSIS: Newman & Ross, 1971:169.

REFERENCES: Broch, 1922:322; 1931:71; Filhol, 1885:487; Foster, 1967a:83; 1967b:35; Gruvel, 1905a:248; Hutton, 1879:328; Krüger, 1940:464,466; Moore, 1944:333; Pilsbry, 1916:219; Weltner, 1897:271; 1899a:445; 1900:307; Withers, 1924:36; 1953:77,98.

DISTRIBUTION: Australia; New Zealand; Auckland I.; 0-51m. Lower Oligocene. Chatham I.

#### Genus *Elminius* Leach, 1825

*Elminius cristallinus* Gruvel, 1907a:106

SYNONYMY/DIAGNOSIS: Gruvel, 1909a:216 (probably introduced *E. modestus* Darwin).

REFERENCE: Krüger, 1940:470.

DISTRIBUTION: Azores.

*Elminius kingii* Gray, 1831:13

SYNONYMY/DIAGNOSIS: Darwin, 1854b:348; Nilsson-Cantell, 1921:348.

REFERENCES: Gruvel, 1903b:163; 1905a:294; 1911:292; Hoek, 1907:4; Kolosváry, 1943a:95; Krüger, 1940:470; Nilsson-Cantell, 1930c:255; 1957:22; Pilsbry, 1916:260; Weltner, 1895:289; 1897:256; 1898b:5; 1900:305.

DISTRIBUTION: Chile, below 30°S; Cape Horn to Punta Arenas, Argentina; Falkland Is.

*Elminius modestus* Darwin, 1854b:350

SYNONYMY/DIAGNOSIS: Moore, 1944:329 (includes *E. sinatus* Hutton, 1879:328).

REFERENCES: Austin et al, 1958:497 (chromosome numbers); Barnes & Barnes, 1960:137 (recent spread in NW Europe); 1961a:121 (spread in SW Scotland); 1965b:23 (further European records); 1966a:83 (coasts of western Europe); 1968a:135 (egg numbers); 1968b:261 (French Atlantic coast); 1969a:156 (in France); 1974:197 (embryonic development and salinity); Barnes & Klepal, 1971:87 (pedicel of penis); Barnes, Barnes & Klepal, 1972:187 (French Atlantic coast); Barnes, Barnes, Klepal & Munn, 1971:173 (spermatozoa); Barnes & Powell, 1966:107 (at Arcachon, France); Barnes & Stone, 1972b:309 (western Scotland); Bassindale, 1947:223; 1958:381; 1964:42; Beard, 1957:1145; Bhatnagar & Crisp, 1965:419 (salinity tolerance); Bishop, 1947:501 (first report outside Aus-

tralia); 1951:531 (spread in European waters); 1954:1145 (in France); Bishop & Crisp, 1957:482 (in France); 1958:109 (France); Bishop et al, 1957:1 (on French Atlantic coast); Bocquet-Védrine, 1964:5060 (relationship between growth and molting); 1965b:30 (molting); Boschma, 1948:403 (Netherlands); Boulton et al, 1971:487 (fouling); Broch, 1922:342 (as *Elminius sinuatus*); Connell, 1955:954 (Scotland); Corner et al, 1968:29 (toxicity); Crisp, 1955:569 (cyprid behavior); 1958:483; 1959b:37; 1960a:681 (northern limit); 1961:421 (territorial behavior); 1964a:179 (severe winter); Crisp & Austin, 1960:787 (fouling); Crisp & Barnes, 1954:142 (orientation); Crisp & Chipperfield, 1948:64 (British waters); Crisp & Christie, 1966:59 (toxicity); Crisp & Davies, 1955:357 (breeding); Crisp & Meadows, 1962c:500 (gregariousness); Crisp & Patel, 1958:1078; 1961:105 (growth rates); 1967:612 (contour of substratum); Crisp & Ritz, 1967b:236 (temperature acclimation); Crisp & Southward, 1959:429 (spread in British Isles); 1961:271 (cirral activity); Crisp & Stubbings, 1957:179 (orientation); Den Hartog, 1953:9 (in North Sea); 1956:141 (in France); Evans, 1968:260; Filhol, 1885:489; Fischer-Piette, 1963:176 (French/Spanish border); 1964:500 (France); 1965:466 (Fr. Atlantic coast); Fischer-Piette & Prenant, 1956:7 (NW coast Spain); Foster, 1967a:84; 1967b:33 (early stages); 1969:326 (tolerance of high-temperatures); 1970:380 (acclimation to salinity); 1971a:12 (desiccation); 1971b:33 (upper limit); Foster & Nott, 1969:340 (sensory structures); Gruvel, 1903b:163; 1905a:295 (as *Elminius sinuatus*), 296; Guiler, 1952:20; Hutton, 1879:328 (as *E. sinuatus*); Jennings, 1918:62; Jones, 1961:103 (SE coast of Scotland); Knight-Jones, 1948:201 (British harbors); 1953:583 (gregariousness); 1955:266 (gregariousness); Knight-Jones & Crisp, 1953:1109 (gregariousness); Knight-Jones & Morgan, 1966:267 (hydrostatic pressure); Knight-Jones & Stephenson, 1950:281 (gregariousness); Knight-Jones & Waugh, 1949:413 (larval development); Kolosváry, 1967b:393; Krüger, 1940:470; Kuhl, 1963:99 (German coast); 1967:965 (Elbe estuary); Leloup & Lefevre, 1952:1 (Belgian coast); Meadows, 1969a:273 (fouling); 1969b:65 (settlement, growth); Moore, 1944:329; Moyse, 1963:175 (food for larvae); Moyse & Nelson-Smith, 1963:1 (zonation); Nilsson-Cantell, 1921:351; 1925:42 (as var. *laevis* n.var.); 1926:13; 1927a:786; 1930d:212; O'Riordan, 1967:294 (Ireland); Patel & Crisp, 1960a:667 (influence of temperature); 1961:89 (breeding and molting); Pope, 1945:368; 1966:181; Powell, 1960:119 (Scotland); Ritz & Foster, 1968:552 (temperature); Roskell, 1962:263 (on *Littorina* shells); Sandison, 1950:79 (S. Africa); Singarajah et al, 1967:144 (phototactic behavior); Skerman, 1958:224 (fouling); 1960:610 (predation); Southward, 1955b:403 (behavior); 1955c:423 (behavior); Southward & Crisp, 1952:416 (changes in distribution); 1963:24 (fouling); Stubbings, 1950:277; Utinomi, 1968b:178; Walker, 1970:239 (cement apparatus); 1973b:455 (frontal horns and gland cells); Weltner, 1897:256,257 (as *Elminius sinuatus*); 1900:307; Wisely & Blick, 1964:162 (nauplii); Zevina, 1963:73 (Black Sea).

DISTRIBUTION: Australia, Tasmania, New Zealand; introduced to South Africa, possibly Azores (see *E. cristallinus* Gruvel), Black Sea and Northern Europe.

*Elminius modestus molluscorum* Kolosváry, 1942c:147  
 REFERENCE: Kolosváry, 1943a:95.

DISTRIBUTION: Auckland, New Zealand.

#### Genus *Membranobalanus* Pilsbry, 1916

*Membranobalanus brachialis* (Rosell), 1973:184

DISTRIBUTION: Puerto Galera, Philippines.

*Membranobalanus cuneiformis* (Hiro), 1936b:627

SYNONYMY/DIAGNOSIS: Hiro, 1939c:243.

DISTRIBUTION: Arrafura Sea and Japan; 15m.

- Membranobalanus declivis* (Darwin), 1854b:275  
 SYNONYMY/DIAGNOSIS: Barnes & Klepal, 1971:86 (pedicel of penis); Pilsbry, 1916:230.  
 REFERENCES: Gravel, 1905a:244; Henry, 1954:443; 1958: 215; Hiro, 1936:631; Verrill, 1901:22 (as *Balanus declivus cuspidatus* n.subsp.); Wells, 1966:83; Weltner, 1897:270.  
 DISTRIBUTION: Bermuda; Florida; West Indies.
- Membranobalanus longirostrum* (Hoek), 1913:205  
 SYNONYMY: Utinomi, 1968b:176.  
 DIAGNOSIS: Hoek, 1913:205; Utinomi, 1968b:176.  
 REFERENCES: Broch, 1931:85; 1947:6; Daniel, 1955:26 (as *Balanus longirostrum* var. *krusadaiensis* nov.); Dawyoff, 1952:128; Daniel & Prem-Kumar, 1968:147 (as *Balanus (Membranobalanus) roonwali* n.sp.); Hiro, 1936b:631; Nilsson-Cantell, 1921:340; 1938b:54; Suhaimi, 1966:65 (as *Balanus (M.) basicupula* n.sp.); Weltner, 1897:270 (as ?*Balanus declivis*).  
 DISTRIBUTION: East coast of India to Singapore; 6-36m.
- Membranobalanus nebris* (Zullo & Beach), 1973:2  
 DISTRIBUTION: Galapagos Is.
- Membranobalanus orcutti* (Pilsbry), 1907b:361  
 SYNONYMY/DIAGNOSIS: Pilsbry, 1907b:361  
 REFERENCES: Barnard, 1924:75; Henry, 1942:127; Hiro, 1936b:631; Pilsbry, 1916:233.  
 DISTRIBUTION: Monterey to Baja California; South Africa; Sulu Arch.; to 52m.
- Membranobalanus orcuttiformis* (Kolosvary), 1941:189  
 DISTRIBUTION: Indian Ocean.
- Genus *Acasta* Leach, 1817
- Acasta aculeata* Nilsson-Cantell, 1921:342  
 DISTRIBUTION: Gulf of Siam.
- Acasta alba* Barnard, 1924:83  
 DISTRIBUTION: Off Natal, South Africa; 90-180m.
- Acasta alcyonicola* Utinomi, 1953:142  
 SYNONYMY/DIAGNOSIS: Utinomi, 1953:142.  
 REFERENCE: Utinomi, 1959c:313.  
 DISTRIBUTION: Tanabe Bay, Japan.
- Acasta angusticalcar* Broch, 1931:106  
 SYNONYMY/DIAGNOSIS: Broch, 1931:106.  
 DISTRIBUTION: Kei Is.; 20m.
- Acasta antipathidis* Broch, 1916:13  
 SYNONYMY/DIAGNOSIS: Broch, 1916:13.  
 REFERENCES: Hiro, 1936a:58; 1937b:53 (possibly a *Conopea*).  
 DISTRIBUTION: Cape Jaubert, western Australia.
- Acasta armata* Gravier, 1921a:353  
 DISTRIBUTION: Off Djibouti; 20m.
- Acasta cancellorum* Hiro, 1931:151  
 SYNONYMY/DIAGNOSIS: Hiro, 1937c:459.  
 REFERENCES: Nilsson-Cantell, 1938b:58.  
 DISTRIBUTION: Seto, Japan.
- Acasta conica* Hoek, 1913:235  
 SYNONYMY/DIAGNOSIS: Hoek, 1913:235.  
 REFERENCES: Broch, 1922:330.  
 DISTRIBUTION: Celebes; Sulu Arch.; 40-60m.
- Acasta coriobasis* Broch, 1947:25  
 SYNONYMY/DIAGNOSIS: Utinomi, 1953:139.  
 REFERENCE: Dawyoff, 1952:139.  
 DISTRIBUTION: Indochina; Hiroshima Bay.
- Acasta crassa* Broch, 1931:109  
 DISTRIBUTION: Saparua Bay, Moluccas; 20-30m.
- Acasta ctenodentia* Rosell, 1972:200  
 DISTRIBUTION: Puerto Galera, Philippines.
- Acasta cyathus* Darwin, 1854b:312  
 SYNONYMY: Darwin, 1854b:312.  
 DIAGNOSIS: Pilsbry, 1916:244.  
 REFERENCES: Annandale, 1906:144; Barnard, 1924:82; Broch, 1922:330; 1927c:30; 1931:95; Gravier, 1921a:357; Gruvel, 1903b:121; 1905a:259; Henry, 1954:443; Hoek, 1913:xvi,xix; Nilsson-Cantell, 1921:342; 1938:13; Pilsbry, 1916:244; 1952:27; Stubbings, 1936:48; Wells, 1966:85; Weltner, 1897:258; 1910:528; 1922:85; Zevina & Litvinova, 1970:174.
- DISTRIBUTION:* Florida; Caribbean; Madeira; Morocco; East Africa; Red Sea; Gulf of Manaar; Singapore; Kei Is.; Sulu Arch.; Philippines; western Australia; 15-180m.
- Acasta denticulata* Hiro, 1931:153  
 SYNONYMY/DIAGNOSIS: Hiro, 1931:153.  
 REFERENCE: Utinomi, 1958a:309.  
 DISTRIBUTION: Sagami Bay, Japan.
- Acasta dolfleini* Krüger, 1911a:56  
 SYNONYMY: Hiro, 1937d:454.  
 DIAGNOSIS: Broch, 1922:330.  
 REFERENCES: Broch, 1931:96; Dawyoff, 1952:129; Hiro, 1931:151 (as *Acasta aperta* n.sp.); Krüger, 1911b:461; Nilsson-Cantell, 1921:341; Pilsbry, 1916:247; Rosell, 1972:198; Utinomi, 1950:64; 1958a:309; 1962:221; 1968b:178; 1969b:53.  
 DISTRIBUTION: Southern Japan; Indonesia; Sulu Arch.; 24-280m.
- Acasta echinata* Hiro, 1937a:70  
 SYNONYMY: Utinomi, 1962:224.  
 DIAGNOSIS: Broch, 1947:6; Utinomi, 1949a:32.  
 REFERENCES: Dawyoff, 1952:129; Utinomi, 1959c:313.  
 DISTRIBUTION: Southern Japan; southeast Asia; 15-20m.
- Acasta fenestrata* Darwin, 1854b:316  
 SYNONYMY: Rosell, 1972:194.  
 DIAGNOSIS: Darwin, 1854b:316.  
 REFERENCES: Gruvel, 1905a:262; Hiro, 1939d:243; Hoek, 1883:160; 1913:233; Krüger, 1911a:4; 1911b:461; Nilsson-Cantell, 1938b:57; Weltner, 1897:259; 1922:104.  
 DISTRIBUTION: Red Sea; Bay of Bengal; Philippines; Seto, Japan; to 51m.
- Acasta fischeri* Locard, 1877:18  
 DISTRIBUTION: Miocene, Sicily, Sardinia and Corsica.
- Acasta flexuosa* Nilsson-Cantell, 1931a:130  
 SYNONYMY: Hiro, 1937c:457.  
 DIAGNOSIS: Hiro, 1931:153 (as *Acasta amakusana* n.sp.).  
 REFERENCES: Utinomi, 1949a:32.  
 DISTRIBUTION: Amakusa and Seto, Japan.
- Acasta foraminifera* Broch, 1931:98  
 DISTRIBUTION: Amboina Bay, Kei Is.; 100-140m.
- Acasta formae* de Alessandri, 1897:46  
 REFERENCE: de Alessandri, 1906:312; Withers, 1953:61.  
 DISTRIBUTION: Miocene, Italy.
- Acasta fossata* Barnard, 1924:84  
 DISTRIBUTION: Seal I., S. Africa; 24-50m.
- Acasta glans* Lamarck, 1818:398  
 SYNONYMY: Utinomi, 1969a:91.  
 DIAGNOSIS: Hoek, 1913:241.  
 REFERENCES: Broch, 1931:133; Darwin, 1854b:314; Gruvel, 1903b:121; 1905a:261; Hoek, 1913:233; Kolosvary, 1943a:94; Nilsson-Cantell, 1938b:56; Pilsbry, 1916:242; Weltner, 1897:258.  
 DISTRIBUTION: Gulf of Iran; Bay of Bengal; southwest Australia; Indonesia; Philippines; 15-55m.
- Acasta gregaria* Utinomi, 1959c:314  
 DISTRIBUTION: Tanabe Bay, Japan.
- Acasta hirsuta* Broch, 1916:10  
 SYNONYMY/DIAGNOSIS: Broch, 1916:10.  
 REFERENCES: Broch, 1931:96; Hiro, 1936a:58; Utinomi, 1959c:317.  
 DISTRIBUTION: Cape Jaubert, Australia; Amboina; Moluccas; 100-140m.
- Acasta idiopoma* Pilsbry, 1912:294  
 REFERENCE: Pilsbry, 1916:247.  
 DISTRIBUTION: Mindanao, Philippines; 40m.
- Acasta japonica* Pilsbry, 1911:80  
 SYNONYMY: Utinomi, 1962:221.  
 DIAGNOSIS: Pilsbry, 1911:80.  
 REFERENCES: Broch, 1922:330; 1931:96; 1947:6; Dawyoff, 1952:129; Hiro, 1939f:213; Krüger, 1940:460; Nilsson-Cantell, 1938b:13; Pilsbry, 1916:243; Utinomi, 1970:359; Zullo, 1968a:227.  
 DISTRIBUTION: Southern Japan; Taiwan; southeast Asia; 10-800m.

- Acasta laevigata* Gray, 1825:103  
 SYNONYMY: Nilsson-Cantell, 1938b:57.  
 DIAGNOSIS: Darwin, 1854b:315; Hiro, 1937b:62.  
 REFERENCES: Gruvel, 1903b:121; 1905a:261; Hoek, 1913:233; Rosell, 1972:197; Weltner, 1897:259; Zevina & Litvinova, 1970:174.  
 DISTRIBUTION: Red Sea; Zanzibar; Andaman Is., Philippines; Palau Is.
- Acasta membranacea* Barnard, 1924:88  
 REFERENCE: Nilsson-Cantell, 1938b:13.  
 DISTRIBUTION: South Africa; 28-180m.
- Acasta microforamina* Rosell, 1970:105  
 DISTRIBUTION: Philippines.
- Acasta muricata* Seguenza, 1876:312  
 DISTRIBUTION: Tertiary, Italy (Withers, 1953:62).
- Acasta pectinipes* Pilsbry, 1912:294  
 SYNONYMY: Hiro, 1937c:463.  
 DIAGNOSIS: Nilsson-Cantell, 1938b:57.  
 REFERENCES: Barnard, 1924:87; 1925:1; Broch, 1922:330; Hiro, 1931:149 (as *Acasta komaii* n.sp.); Hoek, 1913:237 (as *Acasta nitida* n.sp.); Krüger, 1914:438; Pilsbry, 1916:247; Utinomi, 1949a:23; 1962:221; 1969b:53; Zullo, 1968a:227.  
 DISTRIBUTION: Japan; Philippines; Sulu Arch.; Java Sea; Andaman Is.; South Africa; 35-170m.
- Acasta porata* Nilsson-Cantell, 1921:348  
 SYNONYMY: Nilsson-Cantell, 1938b:56.  
 DIAGNOSIS: Broch, 1931:96.  
 REFERENCES: Broch, 1947:6; Dawyoff, 1952:129; Rosell, 1972:203.  
 DISTRIBUTION: Philippines; Viet Nam; Bay of Bengal; 1-55m.
- Acasta purpurata* Darwin, 1854b:318  
 SYNONYMY/DIAGNOSIS: Darwin, 1854b:318.  
 REFERENCES: Gruvel, 1905a:262; Hiro, 1937c:450; Hoek, 1913:234; Nilsson-Cantell, 1938b:13; Utinomi, 1959c:313; Weltner, 1897:259.  
 DISTRIBUTION: Sumatra; Philippines.
- Acasta sarda* de Alessandri, 1895:64  
 REFERENCES: de Alessandri, 1906:311; Withers, 1953:59.  
 DISTRIBUTION: Oligocene, Sicily.
- Acasta schäfferi* de Alessandri, 1910:124  
 DISTRIBUTION: Miocene, Austria (Withers, 1953:70).
- Acasta sculptura* Broch, 1931:101  
 REFERENCE: Utinomi, 1959c:313.  
 DISTRIBUTION: Java Sea; 49m.
- Acasta scuticosta* Weltner, 1887:102  
 SYNONYMY/DIAGNOSIS: Weltner, 1887:102.  
 REFERENCES: Gruvel, 1905a:260; Hiro, 1931:152; Hoek, 1913:233; Weltner, 1897:259.  
 DISTRIBUTION: Cartagena, Spain.
- Acasta semota* Hiro, 1933:73  
 DISTRIBUTION: East coast of Japan; 33m.
- Acasta serrata* Hiro, 1937b:64  
 DISTRIBUTION: Palau Is.
- Acasta spinitergum* Broch, 1931:112  
 SYNONYMY/DIAGNOSIS: Broch, 1931:112.  
 REFERENCES: Hiro, 1936a:58; Kolosváry, 1943a:95; Utinomi, 1959c:313.  
 DISTRIBUTION: Java Sea; Philippines; 35m.
- Acasta spinifera* Utinomi, 1967:222  
 DISTRIBUTION: Tokyo Bay; 70m.
- Acasta spinosa* Hiro, 1939e:267  
 DISTRIBUTION: Formosa.
- Acasta spongites* Poli, 1791:25  
 SYNONYMY: Darwin, 1854b:308.  
 DIAGNOSIS: Utinomi, 1958a:300.  
 REFERENCES: Barnard, 1924:80; Bassindale, 1964:42; Bocquet-Védrine, 1966a:2733; 1966b:337 (structure and growth of operculum); 1966c:693; Crisp & Southward, 1961:271 (cirral acrivity); Dawyoff, 1952:129; de Alessandri, 1907b:289; Fischer, 1872:433; Gruvel, 1903b:121; 1905a:263; Hiro, 1931:154; 1935c:227; Hoek, 1875:60; 1909:271; Kolosváry, 1939a:176; 1941c:156; 1943a:94;
- 1947a:22; Krüger, 1911a:4; 1911b:459; 1914:439; 1940:459; LeReste, 1965:65 (larvae); Moroni-Ruggieri, 1952:77; Moyse, 1960:120 (laboratory rearing); 1961:371 (larval stages); Nilsson-Cantell, 1938b:13; Pilsbry, 1916:242; Relini, 1969:169; Riedl, 1963:258; Stebbings, 1910:570; Utinomi, 1969a:82; Weltner, 1897:259; 1898:11; Zevina & Litvinova, 1970:174.  
 DISTRIBUTION: British Isles; France; Portugal; Mediterranean; Red Sea; South Africa; Australia; Japan. Pliocene: France and Italy.
- Acasta sporillus* Darwin, 1854b:319  
 SYNONYMY/DIAGNOSIS: Darwin, 1854b:319.  
 REFERENCES: Gruvel, 1905a:260; Hiro, 1931:150; Hoek, 1913:233; Weltner, 1897:259.  
 DISTRIBUTION: Sulu Arch.
- Acasta striata* Gruvel, 1901:262  
 SYNONYMY/DIAGNOSIS: Gruvel, 1905a:264.  
 REFERENCE: Hoek, 1913:233.  
 DISTRIBUTION: Off Madeira; 400m.
- Acasta sulcata* Lamarck, 1818:398  
 SYNONYMY: Darwin, 1854b:310; Hiro, 1937c:451.  
 DIAGNOSIS: Stubbings, 1961a:174.  
 REFERENCES: Borradale, 1903:442; Broch, 1947:6; Dawyoff, 1952:129; Gruvel, 1903b:121; 1905a:263; Kolosváry, 1947e:361; Krüger, 1911a:56; 1911b:461; Nilsson-Cantell, 1938b:13; Utinomi, 1950:64; 1958a:309; 1969a:82; Weltner, 1897:259; Zevina & Litvinova, 1970:174.  
 DISTRIBUTION: Red Sea; Persian Gulf; Maldives; Gulf of Siam; South China Sea; Viet Nam; Australia; Philippines; Japan; 5-25m.
- Acasta sulcata anchoris* Barnard, 1924:81  
 REFERENCES: Nilsson-Cantell, 1938b:13; Zevina & Litvinova, 1970:174.  
 DISTRIBUTION: Natal, South Africa; 28m.
- Acasta sulcata spinosa* Daniel, 1955:29  
 DISTRIBUTION: Off Madras, Bay of Bengal.
- Acasta tenuivalvata* Broch, 1947:28  
 REFERENCE: Dawyoff, 1952:129.  
 DISTRIBUTION: Viet Nam; 15m.
- Acasta tulipa* Hiro, 1933:76  
 DISTRIBUTION: Off southern Japan; 126m.
- Acasta undulata* Darwin, 1854a:34  
 DISTRIBUTION: Upper Pliocene, England (Withers, 1953:53).
- Acasta umitosaka* Utinomi, 1962:224  
 DISTRIBUTION: Nomosaki, Japan.
- Acasta zuiho* Hiro, 1936b:632  
 DISTRIBUTION: Off Port Darwin, Australia.
- Genus *Pseudoacasta* Nilsson-Cantell, 1930
- Pseudoacasta libera* Nilsson-Cantell, 1930a:1  
 SYNONYMY/DIAGNOSIS: Nilsson-Cantell, 1930b:11.  
 DISTRIBUTION: Moluccas.
- Genus *Conopea* Say, 1822
- Conopea acuta* (Nilsson-Cantell), 1921:334  
 DISTRIBUTION: Kyusyu, Japan.
- Conopea calceola* (Ellis), 1758:853  
 SYNONYMY: Hiro, 1937c:443.  
 DIAGNOSIS: McLaughlin & Henry, 1972:24.
- REFERENCES: de Alessandri, 1895:281; 1906:299; Broch, 1922:325; 1924b:202; 1927c:29; 1931:85; Daniel, 1955:28; Darwin, 1854a:15; 1854b:218; Davadie, 1963:35; Gauld, 1957:10; Gruvel, 1903b:130; 1905a:221; 1907b:164; 1909b:25; Hoek, 1913:221; Kolosváry, 1947e:361; Krüger, 1911a:4; 1911b:460; 1940:459; Nilsson-Cantell, 1928a:34; 1938a:180; 1938b:55; Pilsbry, 1916:238; Relini, 1969:175; Stebbing, 1910:568; Stubbings, 1963b:36; 1964:343; 1967:290; Utinomi, 1949a:23; 1950:60; 1958a:296; 1959b:403; 1962:218; 1969a:91; 1969b:53; Utinomi & Kikuchi, 1966:6; Weltner, 1897:262; Withers, 1953:61.
- DISTRIBUTION: Mediterranean to South Africa; Indian Ocean; Persian Gulf to western Australia and Japan;

- 18-250m. Miocene to Pleistocene, Italy; Coralline Crag, England.
- Conopea cornuta* (Hoek), 1913:227  
 REFERENCES: Broch, 1931:87; Utinomi, 1962:219; Utinomi & Kikuchi, 1966:6.  
 DISTRIBUTION: Banda Sea to Japan; 32-140m.
- Conopea cymbiformis* (Darwin), 1854b:221  
 SYNONYMY: Utinomi, 1962:219.  
 DIAGNOSIS: Darwin, 1854b:221.  
 REFERENCES: Broch, 1922:326; 1931:85; Daniel, 1955:28; Dawyoff, 1952:128; Foster, 1974:48; Gruvel, 1905a:222; Hiro, 1935a:25; Hoek, 1913:228 (as *Balanus proripiens* n.sp.), 262 (as *Pyrgoma jedani* n.sp.); Krüger, 1911a:4 1911b:460; 1940A:464; Nilsson-Cantell, 1921:331; Stubbings, 1935:48; Utinomi, 1949a:23; 1958a:297; Utinomi & Kikuchi, 1966:6.  
 DISTRIBUTION: Indo-west Pacific; Gulf of Aden; India; Indonesia; Philippines; Japan; 27-453m.
- Conopea dentifer* (Broch), 1922:326  
 REFERENCES: Broch, 1931:88; Kolosváry, 1967b:392; Krüger, 1940:464.  
 DISTRIBUTION: Tonga I.; Japan; Kei Is., 180m.
- Conopea folliculus* Hiro, 1937b:53  
 DISTRIBUTION: Marianas Is.; on antipatharian.
- Conopea fragilis* (Broch), 1931:92  
 REFERENCES: Krüger, 1940:464.  
 DISTRIBUTION: Amboina Bay; 100-140m.
- Conopea galeata* (Linnaeus), 1771:544  
 SYNONYMY: Ross, 1962:31.  
 DIAGNOSIS: Pilsbry, 1916:236.  
 REFERENCES: Caziot, 1921:52; Cornwall, 1951:325; Darwin, 1854b:220; Gomez, 1973:163 (settling sites); 1975:105 (sex determination); Gomez et al, 1973:813 (effect of juvenile hormone mimics on metamorphosis); Gravier, 1921b:430; Gruvel, 1903b:130; 1905a:222; Henry, 1942: 126; 1954:443; Kolosváry, 1943a:93; Krüger, 1940:464; McDougall, 1943:343; McLaughlin & Henry, 1972:13 (comparative morphology of complemental males); Molenock & Gomez, 1972:100 (larval stages); Mörsch, 1852:67; Nilsson-Cantell, 1931a:114; 1939a:3; Patton, 1963:522; Pilsbry, 1907d:204; 1927:37; 1953:25; Ramenofsky, et al, 1974:172 (juvenile hormones and metamorphosis); Say, 1822:323 (as *Conopea elongata*); Wells, 1966:84; Weltner, 1897:262; Zevina & Kurshakova, 1973:183; Zullo, 1966b:237.  
 DISTRIBUTION: North Carolina through West Indies and Gulf of Mexico to Venezuela; Southern California to Panama and Galapagos Is.; 2-540m.
- Conopea granulata* (Hiro), 1937c:444  
 SYNONYMY/DIAGNOSIS: Hiro, 1937c:444.  
 REFERENCES: Hiro, 1939e:266; Utinomi, 1949a:23; 1950:64; 1958a:307; 1962:220; 1970:359; Utinomi & Kikuchi, 1966:6.  
 DISTRIBUTION: Japan; Taiwan; 90-200m.
- Conopea investita* (Hoek), 1913:244  
 REFERENCES: Pilsbry, 1916:235.  
 DISTRIBUTION: Java and Banda Seas; 73-90m.
- Conopea longibasis* Hiro, 1937b:52  
 DISTRIBUTION: Palau Is.
- Conopea merrilli* Zullo, 1966b:237  
 REFERENCES: McLaughlin & Henry, 1972:13 (complemental males).  
 DISTRIBUTION: North Carolina; Gulf coast of Florida; Puerto Rico; 2-46m.
- Conopea mobergi* Borch, 1916:7  
 DISTRIBUTION: Cape Jaubert, Australia; on *Echinogorgia*.
- Conopea navicula* (Darwin), 1854b:221  
 SYNONYMY: Utinomi, 1962:218.  
 DIAGNOSIS: Hoek, 1913:223.  
 REFERENCES: Dawyoff, 1952:128; Gruvel, 1905b:222; Krüger, 1940:464; Nilsson-Cantell, 1938b:55; Stubbings, 1936:48; Utinomi, 1969a:91; Utinomi & Kikuchi, 1966:6.  
 DISTRIBUTION: Indo-west Pacific; Gulfs of Aden, Persia and Siam; Indonesia; southern Japan; 45-220m.

- Conopea pygmaea* (Broch), 1931:88  
 DISTRIBUTION: Banda Sea; 85m.
- Conopea scandens* (Pilsbry), 1916:239  
 REFERENCES: Barnard, 1924:76; Krüger, 1940:464; Nilsson-Cantell, 1921:334; Utinomi, 1958a:308.  
 DISTRIBUTION: Japan; South Africa; 110-250m.
- Genus *Eoceratoconcha* Newman and Ladd, 1974
- Eoceratoconcha kugleri* Newman & Ladd, 1974:387  
 DISTRIBUTION: Middle Miocene, Trinidad.
- Eoceratoconcha renzi* Newman & Ladd, 1974:389  
 DISTRIBUTION: Middle Miocene, Trinidad.
- Subfamily Semibalaninae n. subfam.
- Genus *Semibalanus*, Pilsbry, 1916
- Semibalanus balanoides* (Linnaeus), 1767:1108  
 SYNONYMY: Darwin, 1854b:267; Pilsbry, 1916:183; Nilsson-Cantell, 1921:328.  
 DIAGNOSIS: Darwin, 1854b:267; Pilsbry, 1916:183; Stubbings, 1975:1.  
 REFERENCES: Allison & Cole, 1935:34; Arnold, 1970:1045 (response to lowered salinity); Arvy & Lacombe, 1968:1326; Arvy & Liguori, 1968:817; Arvy et al, 1968:817; Arvy & Nigrelli, 1969:95 (epizoic peritriches in branchial cavity); Arvy et al, 1969:351; Aurivillius, 1898b:29; Austin et al, 1958:497 (chromosomes); Barnes, 1950:73 (larvae); 1952:53:104 (rate of growth); 1953b:328 (lowered salinity); 1953d:429 (southern limits); 1953e:297 (size variations); 1955a:109 (growth rate); 1955b:114 (hatching); 1955c:341 (rugophilic behavior); 1956a:72 (larval population); 1957a:1 (northern limits); 1957b:67 (spawning); 1958:139 (southern limits); 1959c:234 (temperature and life cycle); 1961a:592 (observations on southern limit); 1961b:427 (growth rate); 1962b:462 (anecdysis); 1963a:717 (breeding); 1965:321 (egg biochemistry); Barnes & Barnes, 1958b:160 (opening response); 1958c:29 (rate of larval development); 1959a:1 (growth patterns); 1959b:19 (stimulation of nauplii); 1959e:242 (egg mass development); 1959g:581 (growth); 1962:1 (distribution); 1963:93 (egg development); 1965a:391 (variation in egg size); 1966a:83 (observations on western European mainland); 1967:1 (starvation); 1968a:135 (variation in egg production); 1969b:36 (oxygen consumption); 1969c:136 (limits in France); 1974:197 (embryonic development and salinity); Barnes et al, 1963:213 (metabolism); 1970:70 (behavior on impaction); 1971:173 (spermatozoa); 1972:189 (on French Atlantic coast); Barnes & Finlayson, 1963:185 (seasonal changes); Barnes & Healy, 1965:779 (biometrical studies); Barnes & Klepal, 1971:85 (Pedicel of penis); Barnes & Powell, 1950a:175 (development, morphology and elimination); 1966:107 (at Arcachon, France); Barnes & Stone, 1972a: 303 (penis development); 1974:275 (food, temperature, photoperiod and molting); Bassindale, 1936:57 (development); 1958:381 (in England); Belyaev, 1949:901 (osmoregulation); Bhatnagar & Crisp, 1965:419 (salinity tolerance of larvae); Bishop et al, 1957:3 (in France); Blom & Nyholm, 1961:149 (settling time, Sweden); Bourget & Crisp, 1975a:231 (shell deposition); 1975b:221 (early changes in shell form); Bousfield, 1954:118; 1955a:1 (ecology — Miramichi estuary); 1955b:763; Brattstrom, 1957:5; Brocchi, 1814:598; Broch, 1924a:84; 1927b:22; Caziot, 1921:52; Chipperfield, 1948:13 (breeding and settlement); 1949:17 (environmental conditions); Ciurea et al, 1933:6; Cole, 1929:599 (temperature and pedal rhythm); 1932a:611 (stimulation); 1932b:143 (stimulation); Cole & Allison, 1935:25 (stimulation); 1937:405 (electrolytes); Connell, 1957:1; 1959:226 (recruitment and mortality); Cook et al, 1972:409 (amino acid composition); Cook & Gabbott, 1970:11 (glycerol level); Cook &

Lewis, 1971:26 (cold tolerance); Crisp, 1953:331 (changes in orientation); 1955:569 (cyprid behavior); 1956:263 (hatching); 1959a:275 (breeding); 1959c:119 (embryo development); 1960b:95 (growth); 1960c:1208 (mobility); 1961:429 (behavior); 1962a:207 (planktonic stages); 1964a:165 (effect of severe winter); 1964b:33 (racial differences); 1968a:2633 (difference in N. American and European populations); 1968b:1161 (distribution of parasitic isopod); 1969:1037 (hatching substance); Crisp & Austin, 1960:787 (fouling); Crisp & Barnes, 1954:142 (orientation); Crisp & Clegg, 1960:265 (induction of breeding); Crisp & Knight-Jones, 1953:360 (aggregation); Crisp & Meadows, 1962:500 (chemical basis of gregariousness); 1963:364 (stimulus to settlement); Crisp & Patel, 1958:1078 (breeding and ecdysis); 1960:31 (molting); 1967:612 (contour of substratum); 1969:283 (control of breeding); Crisp & Ritz, 1967a:98 (temperature tolerance); 1967b:236 (temperature acclimation); 1974:327 (larval response to light); Crisp & Southward, 1961:271 (cirral activity); Crisp & Spencer, 1958:278 (hatching); Crisp & Stubbings, 1957:179 (orientation); Crisp et al., 1967:629 (toxic action); Daniel, 1955c:23; Davadie, 1963:70; Dawson & Barnes, 1966:249 (lipid composition); Fales, 1928:534 (light receptive organs); Fischer, 1929:10 (distribution in English Channel); Fischer, 1872:433 (southwestern coast of France); Fischer, 1943:65 (distribution — North Sea) Fischer-Piette, 1930:39 (St. Servan); Fischer-Piette and Prenant, 1956:8 (northern Spain); Forbes et al., 1971:539 (orientation to light); Foster, 1969:326 (tolerance of high temperatures); 1970:377 (acclimation to salinity); 1971a:12 (desiccation); 1971b:33 (upper limits of intertidal distribution); Gabbott & Larman, 1971:143 (electrophoretic examination); Gibson & Nott, 1971:227 (larvae); Gordon, 1969:139 (salinity & distribution); Grainger & Newell, 1965:469 (aerial respiration); Groom, 1894b:81; 1895a:1; 1895b:269 (cyprid stage); Gruvel, 1903b:139; 1905a:241; 1909a:225; Gutmann, 1960:1 (morphology); 1962:193 (breeding/molting); Hatai, 1939b:267; Hatton & Fischer-Piette, 1932:1 (settling and growth); Haven, 1973:97 (ecology); Henry, 1942:100; Hiro, 1935d:222; Hoek, 1875:37 (Netherlands coast); 1884:519; Kauri, 1962:131 (nauplius eye); 1966:115 (sensory papilla X-organ); Kaye, 1964:580 (as index of sea level changes); Klepal & Barnes, 1974:205 (penis regeneration); Klugh & Newcombe, 1935:39 (light control); Knight-Jones, 1953:583 (gregariousness); 1955:266 (gregariousness); Knight-Jones & Crisp, 1953:1109 (gregariousness-fouling); Knight-Jones & Morgan, 1964:29 (barosensitivity); 1966:267 (hydrostatic pressure); Kolosváry, 1943a:91; 1962d:201; Krüger, 1927a:14; 1927b:5; 1940:464; Kühl, 1963:99; 1965:113; 1967:965; 1968:1; Lacombe, 1970:164 (cement glands); Meadows, 1969a:273 (fouling communities); 1969b:65; Mohammad, 1962:488; Moore, 1934a:101 (growth rate); 1934b:851 (growth); 1935b:264 (soft parts); 1935c:279 (ecology); 1936:701 (distribution); Moore & Kitching, 1939:521 (comparison with *C. stellatus*); Moore & Parke, 1935:49 (algal infection); Mørch, 1852:68; Moyse, 1960:120 (laboratory rearing); 1963:176 (food for larvae); Müller, 1940:113 (sensitivity to poisons); Munn & Barnes, 1970a:277 (spermatozoa); 1970b:261 (spermatozoa); Munn, Klepal & Barnes, 1974:89 (structure and function penis sensory setae); Neu, 1935:169 (growth forms); Newell & Northcroft, 1965:387 (cirral activity); Norris et al., 1951:444 (larval stages); Nott, 1969:251; Nott & Foster, 1969:115 (antennular attachment organ); O'Riordan, 1967:292; Patel & Crisp, 1960b:104 (embryo development); 1961:89 (breeding and molting); Petersen, 1962:1 (distribution); 1966:1 (natural history); Poulsen, 1935:17; Prenant & Teissier, 1923:172 (Roscoff); Pyefinch, 1948a:451 (identification of larvae); 1948b:464 (biology); Ritz & Crisp, 1970:223 (feeding); Rosenberg, 1972a:313 (effect of chlorinated hydrocarbons); 1972b:11 (salinity tolerance); Roskell, 1962:263 (epizoic on *Littorina*); Runn-

ström, 1925:1 (biology); Rusanova, 1959:568 (two populations); Rzhepishevskii, 1968:37 (Barents Sea); Schäfer, 1938a:304 (boring organisms); 1938b:323 (paleontology); 1938c:564; 1948:74; 1952:240 (settling); Schwarz, 1932:437 (influence of light); Sizer, 1937:327 (stimulation by acids); Sneli, 1972:3; Southward, 1955b:403 (cirral activity); Southward & Crisp, 1954a:163 (distribution British Isles); 1956:211 (fluctuation in distribution); 1963:35; Stephenson, 1938:5 (Iceland); 1943:20 (E. Greenland); Tarasov, 1937:53; Tarasov & Zevina, 1957:216; Tighe-Ford, 1967:920 (breeding); 1968:225 (techniques); Tighe-Ford & Vaile, 1972a:19 (molting hormone); 1972b:202 (molting hormone); Trusheim, 1932:70 (paleontology); Visscher, 1928b:193 (resistance to fresh water); Walley, 1964:314 (metamorphosis); 1965:115 (oviducal gland); 1967:151 (epidermal gland); 1969:237 (larval structure and metamorphosis); Walley et al., 1971:489 (sperm); Walker, 1970:239 (cement apparatus); 1971:205 (larval cement apparatus); 1973a:305 (early development of cement apparatus); 1973b:455 (frontal horns and gland cells); Wells, 1960:578 (southern limit); Weltner, 1897:269; 1898a:442; 1898b:8,11; 1900:302; Zullo, 1963b:12.

DISTRIBUTION: Atlantic: boreo-arctic, to northern Spain and Cape Hatteras; North Pacific from Unalaska to British Columbia. Miocene, Japan; Pliocene, England; fossil, Caspian Sea region.

*Semibalanus balanoides calcaratus* Pilsbry, 1916:188

SYNONYMY/DIAGNOSIS: Pilsbry, 1916:188.

REFERENCES: Henry, 1942:126; Hiro, 1935c:227.

DISTRIBUTION: Shelikof Strait and Sitka, Alaska.

*Semibalanus cariosus* (Pallas), 1788:240

SYNONYMY/DIAGNOSIS: Pilsbry, 1916:189.

REFERENCES: Barnes, 1959a:231 (stomach contents); Barnes & Barnes, 1959h:515 (metabolism); Barnes & Klepal, 1971:71 (pedicel of penis); Batzli, 1969:531 (distribution of biomass); Connell, 1970:49 (predation); Cornwall, 1924b:41; 1925:462; 1951:322; 1955a:22; 1955b:26; Darwin, 1854b:273; Fahrenbach, 1965:234 (photoreceptors); Gruvel, 1903b:140; 1905a:243; Gwilliam, 1965:244 (physiology); Gwilliam & Bradbury, 1971:502; Hatai, 1938:96; Henry, 1940:13; 1942:102; Hiro, 1932b:472; 1935c:223; 1939f:211; Hoek, 1913:154, 155; Kolosváry, 1967b:391; Kruger, 1911a:54; 1911b:459; Millecchia & Gwilliam, 1972:438 (electrophysiology); Pilsbry, 1911:76; 1921:112; Rice, 1930:249 (peculiarities in distribution); Southward & Crisp, 1965:161 (activity rhythms); Towler, 1930:225 (communities); Tarasov & Zevina, 1957:211; Utinomi, 1955a:119; 1969b:51; 1970:358; Weltner, 1897:270; 1898b:11; 1900:302; Worley, 1939:233 (correlation study); Yamaguchi, 1971:122; Zullo, 1969b:351.

DISTRIBUTION: North Pacific: Japan, Korea, Bering Sea; Unalaska to Central California. Miocene, Japan; Pleistocene, Japan and Oregon.

*Semibalanus madrasensis* (Daniel), 1958:305

DIAGNOSIS: Daniel, 1958:305.

DISTRIBUTION: Bay of Bengal; on local craft.

*Semibalanus sinnurensis* (Daniel), 1962a:193

DIAGNOSIS: Daniel, 1962a:193.

DISTRIBUTION: Porto Novo, India; on *Murex* sp.

## Family Pyrgomatidae Gray, 1825

### Subfamily Pyrgomatinae Gray, 1825

#### Genus *Cantellius* Ross and Newman, 1973

*Cantellius acutum* (Hiro), 1938d:398

SYNONYMY: Utinomi, 1962:227; Ross & Newman, 1973:150.

DIAGNOSIS: Hiro, 1938d:398.

REFERENCES: Darwin, 1854b:379 (as *Creusia spinulosa* var. 6, subvar. 2); Foster, 1974:49; Gruvel, 1905a:300; Hiro, 1935a:25; Kolosváry, 1947e:365; Nilsson-Cantell, 1921:352.

DISTRIBUTION: Philippines; Palau Is.; Japan.

- Cantellius arcuatum* (Hiro), 1938d:395  
 SYNONYMY/DIAGNOSIS: Hiro, 1938d:395.  
 REFERENCES: Kolosváry, 1947d:426; 1947e:364; Ross & Newman, 1973:150.  
 DISTRIBUTION: Palau Is.
- Cantellius brevitergum* (Hiro), 1938d:397  
 SYNONYMY/DIAGNOSIS: Hiro, 1938d:397.  
 REFERENCE: Ross & Newman, 1973:150.  
 DISTRIBUTION: Palau Is.
- Cantellius euspinulosum* (Broch), 1931:118  
 SYNONYMY: Utinomi, 1962:226.  
 DIAGNOSIS: Darwin, 1854b:377; Hiro, 1935a:5.  
 REFERENCES: Annandale, 1924:64; Barnes & Klepal, 1971: 87 (pedicel of penis); Darwin, 1854b:377 (as *Creusia spinulosa* var. 1); Foster, 1974:48; Gruvel, 1903b:164; 1905a:299; Hiro, 1937c:465; 1938d: 393; Kolosváry, 1947e:365; Nilsson-Cantell, 1938b:59; Ross & Newman, 1973:150; Utinomi, 1949a:23.  
 DISTRIBUTION: Pacific coast of Japan; Palau Is.; Sulu Arch.; Indonesia; Singapore; Mergui Arch.; Andamans.
- Cantellius gregarius* (Sowerby), 1823:no pagination  
 SYNONYMY: Ross & Newman, 1973:150.  
 DIAGNOSIS: Darwin, 1854b:378; Nilsson-Cantell, 1938b:30.  
 REFERENCES: Broch, 1931:118; Darwin, 1854b:378 (as *Creusia spinulosa* var. 3); Gruvel, 1905a:299; Hiro, 1935a:25; 1938d:403; Kolosváry, 1947e:362; 1951b:292.  
 DISTRIBUTION: Banda Sea; Singapore; Bay of Bengal; to 70m.
- Cantellius iwayama* (Hiro), 1938d:393  
 SYNONYMY/DIAGNOSIS: Hiro, 1938d:393.  
 REFERENCE: Ross & Newman, 1973:150.  
 DISTRIBUTION: Palau Is.
- Cantellius madreporum* (Borradaile), 1903:443  
 SYNONYMY: Ross & Newman, 1973:150.  
 DIAGNOSIS: Borradaile, 1903:443.  
 REFERENCES: Dawyoff, 1952:128; Hiro, 1935a:25; Hoek, 1913:xvi; Nilsson-Cantell, 1938b:13, 65 (footnote).  
 DISTRIBUTION: Gulf of Siam (?); Maldives.
- Cantellius octavus* Ross & Newman, 1973:152  
 SYNONYMY: Ross & Newman, 1973:152.  
 DIAGNOSIS: Darwin, 1854b:380 (as *Creusia spinulosa* var. 8).  
 REFERENCE: Gruvel, 1905a:300.  
 DISTRIBUTION: Unknown.
- Cantellius pallidus* (Broch), 1931:118  
 SYNONYMY/DIAGNOSIS: Hiro, 1935a:6.  
 REFERENCES: Kolosváry, 1947d:425; 1947e:364; Ross & Newman, 1973:152.  
 DISTRIBUTION: Tanabe Bay, Japan; Singapore; Philippines; Fiji; Banda Sea.
- Cantellius pseudopallidum* (Kolosváry), 1947e:362  
 SYNONYMY: Ross & Newman, 1973:153.  
 DIAGNOSIS: Kolosváry, 1947e:362.  
 DISTRIBUTION: Pacific area.
- Cantellius quintus* Ross & Newman, 1973:153  
 DIAGNOSIS: Darwin, 1854b:379 (as *Creusia spinulosa* var. 5).  
 REFERENCE: Gruvel, 1905a:300.  
 DISTRIBUTION: Unknown.
- Cantellius secundus* (Broch), 1931:118  
 SYNONYMY: Utinomi, 1962:227; Ross & Newman, 1973:153.  
 DIAGNOSIS: Darwin, 1854b:378 (as *Creusia spinulosa* var. 2).  
 REFERENCES: Fishelson, 1971:122; Gruvel, 1903b:164; 1905a:299; Hiro, 1935a:25; 1938a:397; Kolosváry, 1947d: 425; Nilsson-Cantell, 1938b:60; Utinomi & Kikuchi, 1966:7; Zevina & Litvinova, 1970:175.  
 DISTRIBUTION: Japan; China; Palau Is.; Kei Is.; Singapore; Andaman Is.; Red Sea; to 20m.
- Cantellius septimus* (Hiro), 1938d:395  
 SYNONYMY: Ross & Newman, 1973:153.  
 DIAGNOSIS: Darwin, 1854b:380 (as *Creusia spinulosa* var. 7).  
 REFERENCES: Kolosváry, 1941e:9; 1943a:104; 1947d:426; 1947e:364; Nilsson-Cantell, 1921:354.  
 DISTRIBUTION: Philippines; Palau Is.; Indian Ocean.
- Cantellius sextus* (Hiro), 1938:398  
 SYNONYMY: Ross & Newman, 1973:153.  
 DIAGNOSIS: Darwin, 1854b:379 (as *Creusia spinulosa* var. 6, subvar. 3).  
 REFERENCE: Gruvel, 1905a:300.  
 DISTRIBUTION: Philippines; Palau Is.
- Cantellius sumbaeae* (Hoek), 1913:265  
 SYNONYMY: Ross & Newman, 1973:153.  
 DIAGNOSIS: Hoek, 1913:265.  
 DISTRIBUTION: Sunda Is.; to 36m.
- Cantellius transversalis* (Nilsson-Cantell), 1938a:61  
 SYNONYMY: Ross & Newman, 1973:153.  
 DIAGNOSIS: Nilsson-Cantell, 1938a:61.  
 REFERENCES: Darwin, 1854b:379 (as *Creusia spinulosa* var. 6, subvar. 1); Gruvel, 1903b:164; 1905a:300; Nilsson-Cantell, 1921:352.  
 DISTRIBUTION: Philippines; Andaman Is.
- Cantellius tredecim* (Kolosváry), 1947d:426  
 SYNONYMY: Ross & Newman, 1973:153.  
 DIAGNOSIS: Kolosváry, 1947d:426.  
 REFERENCE: Kolosváry, 1947e:365.  
 DISTRIBUTION: Singapore.
- Genus *Hiroa* Ross and Newman, 1973
- Hiroa stubbingi* Ross & Newman, 1973:153  
 DISTRIBUTION: Truk, Caroline Is.
- Genus *Savignium* Leach, 1825
- Savignium crenatum* (Sowerby), 1823:no pagination  
 SYNONYMY: Ross & Newman, 1973:159.  
 DIAGNOSIS: Darwin, 1854b:370.  
 REFERENCES: Annandale, 1924:66 (as *Pyrgoma crenatum* phase *tridacophylliae* nov.); Broch, 1931:120; Edmondson, 1951:187; Gruvel, 1905a:304; Hiro, 1935a:14; 1937c: 468; 1938d:399; Kolosváry, 1943a:95; 1947d:427; 1947e: 366; 1951a:287 (as *Pyrgoma crenatiformis* n. sp.); Nilsson-Cantell, 1938b:13; Pilsbry, 1916:262; Utinomi, 1949a:23; Utinomi & Kikuchi, 1966:7; Weltner, 1897:256.  
 DISTRIBUTION: Japan; Philippines; Line Is.; Palau Is.; Singapore; Mergui Arch.
- Savignium dentatum* (Darwin), 1854b:369  
 SYNONYMY/DIAGNOSIS: Hiro, 1935a:12.  
 REFERENCES: Dawyoff, 1952:128; Gruvel, 1905a:305; 1912a:350; Hiro, 1931:154; 1937c:467; 1938d:400; Kolosváry, 1947e:366; Ross & Newman, 1973:159; Weltner, 1897:256.  
 DISTRIBUTION: Red Sea; Gulf of Siam; New Guinea; Palau Is.; Japan.
- Savignium elongatum* (Hiro), 1931:154  
 SYNONYMY/DIAGNOSIS: Hiro, 1931:154.  
 REFERENCES: Dawyoff, 1952:128; Hiro, 1935a:19; 1937c: 468; 1938d:400; Ross & Newman, 1973:159.  
 DISTRIBUTION: Japan; Palau Is.; Gulf of Siam.
- Savignium milliporum* (Darwin), 1854b:367  
 SYNONYMY: Ross & Newman, 1973:159.  
 DIAGNOSIS: Darwin, 1854b:367.  
 REFERENCES: Barnes & Klepal, 1971:87 (pedicel of penis); Broch, 1931:120; Foster, 1974:49; Gruvel, 1905a:306; Hiro, 1935a:25; 1936a:58; 1938d:401; Hoek, 1913:257; Kolosváry, 1950:292 (as *Pyrgoma milleporae forma typica* nov.; as *Pyrgoma milleporae forma snelli* nov.); Nilsson-Cantell, 1921:355; 1938b:70; Weltner, 1897:256.  
 DISTRIBUTION: Indo-west Pacific, east to Fiji and Palau Is.
- Genus *Creusia* Leach, 1817
- Creusia decima* Ross & Newman, 1973:154  
 SYNONYMY/DIAGNOSIS: Darwin, 1854b:381 (as *Creusia spinulosa* var. 10).  
 DISTRIBUTION: Unknown.
- Creusia indicum* (Annandale), 1924:64  
 SYNONYMY/DIAGNOSIS: Utinomi, 1967:227.  
 REFERENCES: Annandale, 1924:65 (as *Pyrgoma indicum*

phase *merulinæ* nov. and phase *sympylliae* nov.); Baluk & Radwański, 1967b:482; Broch, 1931:118 (as *C. spinulosa angustiradiata* nov.); Darwin, 1854b:381 (as *Creusia spinulosa* var. 11); Hiro, 1935a:7; 1937c:466; 1938d:399; Hoek, 1913:265; Nilsson-Cantell, 1938b:62, 63 (as *C. s. angustiterga* Broch [sic]); Ross & Newman, 1973:154; Utinomi, 1943:16 (juvenile stages); 1962:227; Utinomi & Kikuchi, 1966:7.

DISTRIBUTION: Japan; Palau Is.; Kei Is.; Singapore; Mergui Arch.; to 52m.

*Creusia spinulosa* Leach, 1818:171

SYNONYMY: Ross & Newman, 1973:154.

DIAGNOSIS: Darwin, 1854b:380 (as *Creusia spinulosa* var. 9). REFERENCES: Annandale, 1906:143; 1924:64; Gruvel, 1903b:164; 1909b:26; Kolosváry, 1959:197, 198; Ladd, 1959:963 (*Paleocreusia devonica* — not a barnacle); Weltner, 1897:255.

DISTRIBUTION: Recent, unknown. Miocene, Hungary.

#### Genus *Nobia* Sowerby, 1839

*Nobia conjugatum* (Darwin), 1854b:364

SYNONYMY: Ross & Newman, 1973:155.

DIAGNOSIS: Hiro, 1935a:15.

REFERENCES: Annandale, 1906:143; Broch, 1922:344; 1947:7; Gruvel, 1905a:306; Hiro, 1931:154; 1937c:468; Hoek, 1913:264; Kolosváry, 1947d:427; Nilsson-Cantell, 1938b:13; Weltner, 1897:255.

DISTRIBUTION: Red Sea; Ceylon; Mergui Arch.; Gulf of Siam; Sulu Arch.; Singapore; Japan.

*Nobia grandis* Sowerby, 1839:71

SYNONYMY: Darwin, 1854b:365; Nilsson-Cantell, 1938b:68.

DIAGNOSIS: Darwin, 1854b:365.

REFERENCES: Annandale, 1924:66; Borradaile, 1903:443; Barnes & Klepal, 1971:88 (pedicel of penis); Broch, 1931:120; Darwin, 1854b:365 (? = *Balanus duploconus* Lamarck, 1818 = *Duploconus laevigata* Schlüter, 1838); Dawyodoff, 1952:128; Gruvel, 1905a:307; Hiro, 1931:154; 1935a:16; 1937c:468; 1938d:401; Hoek, 1913:258; Kolosváry, 1947d:427; 1947e:366; Korschelt, 1933:26; Nilsson-Cantell, 1921:357; Ross & Newman, 1973:155; Weltner, 1897:256.

DISTRIBUTION: Mergui Arch.; Maldives; Singapore; Indonesia; Kei Is.; Gulf of Siam; Palau Is.; Japan.

*Nobia halomitrae* (Kolosváry), 1947e:363

SYNONYMY/DIAGNOSIS: Kolosváry, 1947e:363.

REFERENCE: Ross & Newman, 1973:155.

DISTRIBUTION: Unknown.

*Nobia kuri* (Hoek), 1913:259

SYNONYMY/DIAGNOSIS: Hoek, 1913:259.

REFERENCES: Hiro, 1931:155; 1935a:25; Ross & Newman, 1973:155.

DISTRIBUTION: Kei Is.; Banda Sea; 204m.

*Nobia orbicellae* (Hiro), 1934:367

SYNONYMY/DIAGNOSIS: Nilsson-Cantell, 1938b:73.

REFERENCES: Hiro, 1935a:17; 1937c:468; 1938d:401; Kolosváry, 1943a:96; 1947a:427; Ross & Newman, 1973:155.

DISTRIBUTION: Japan; Palau Is.; Fiji; Singapore; Mergui Arch.

*Nobia projectum* (Nilsson-Cantell), 1938b:70

SYNONYMY/DIAGNOSIS: Nilsson-Cantell, 1938b:70.

REFERENCES: Ross & Newman, 1973:155; Utinomi, 1969a:82.

DISTRIBUTION: Persian Gulf; 24m.

#### Genus *Pyrgoma* Leach, 1817

*Pyrgoma cancellata* Leach, 1818:171

SYNONYMY: Hiro, 1935a:10.

DIAGNOSIS: Nilsson-Cantell, 1938b:67.

REFERENCES: Borradaile, 1903:443; Darwin, 1854b:362; Dawyodoff, 1952:128; Gruvel, 1905b:303; Hiro, 1937c:467; 1938d:399; Hoek, 1913:257, 264; Kruger, 1911a:4 (var. *japonica*); 1911b:461; Ross & Newman, 1973:156;

Utinomi, 1958a:309; 1962:227; Utinomi & Kikuchi, 1966:7; Weltner, 1897:255 (as var. *japonica* nov.).

DISTRIBUTION: Pacific coast of central to southern Japan; Philippine Sea; Palau Is.; Gulf of Siam; Mergui Arch.; Maldives.

#### Genus *Pyrgopsella* Zullo, 1967

*Pyrgopsella annandalei* (Gruvel), 1906b:1558

SYNONYMY: Ross & Newman, 1973:163.

DIAGNOSIS: Gruvel, 1907d:8.

REFERENCES: Zullo, 1967a:123 (replacement name for *Pyrgopsis* Gruvel).

DISTRIBUTION: Andaman Is.

*Pyrgopsella stellula* Rosell, 1973a:5

DISTRIBUTION: Sulu Arch.

#### Genus *Hoekia* Ross and Newman, 1973

*Hoekia monticulariae* (Gray), 1831:6

SYNONYMY: Baluk & Radwański, 1967b:487.

DIAGNOSIS: Ross & Newman, 1969:161.

REFERENCES: Annandale, 1924:67; Darwin, 1854b:372; Gruvel, 1905a:308; Hiro, 1931:155; 1935a:18; 1937c:468; Hoek, 1913:264; Kolosváry, 1943a:95; 1947d:427; Nilsson-Cantell, 1938b:66; Robertson, 1970:44.

DISTRIBUTION: Mauritius; Bay of Bengal; Singapore; Japan.

#### Subfamily Ceratoconchinae n. subfam.

##### Genus *Ceratoconcha* Kramberger-Gorjanović, 1889

*Ceratoconcha barbadensis* (Withers), 1926:2

REFERENCE: Nilsson-Cantell, 1938b:63; Ross & Newman, 1973:166.

DISTRIBUTION: Pleistocene, Barbados, West Indies.

*Ceratoconcha conicocystata* Newman & Ladd, 1974:391

DISTRIBUTION: Upper Miocene, Dominican Republic; Middle Miocene, Trinidad.

*Ceratoconcha costata* (Seguenza), 1876:316

SYNONYMY: Baluk & Radwański, 1967b:477; Ross & Newman, 1973:166.

DIAGNOSIS: Seguenza, 1876:316.

REFERENCES: Bogsch, 1957:25; de Alessandri, 1895:299 (as *Pyrgoma costatum*); 1906:322; 1910:115 (as *Pyrgoma cf. anglicum*); Duvergier, in de Alessandri, 1922:228; Kolosváry, 1949:1 (as *Creusia spinulosa* forma *praespinulosa*, nov., fig. 5 only); 1962a:86 (as *Creusia spinulosa* forma *kojumdgievae* nov.) 1967b:393; Moroni, 1967b:17; Prochazka, 1893:20 (as *Creusia moravica* n.sp.); Withers, 1953:61, 63.

DISTRIBUTION: Miocene to Pleistocene of Italy; Miocene of Bulgaria (?) and Hungary.

*Ceratoconcha creusioidea* Newman & Ladd, 1974:392

DISTRIBUTION: Lower Miocene, Jamaica; Middle Miocene, Trinidad.

*Ceratoconcha darwiniana* (Prochazka), 1893:23

SYNONYMY/DIAGNOSIS: Prochazka, 1893:23.

REFERENCES: Baluk & Radwański, 1967b:480; Ross & Newman, 1973:166.

DISTRIBUTION: Miocene, Austria.

*Ceratoconcha diplocona* (Seguenza), 1876:322

SYNONYMY/DIAGNOSIS: Seguenza, 1876:322.

REFERENCE: Ross & Newman, 1973:166; Withers, 1953:61.

DISTRIBUTION: Pliocene, Italy.

*Ceratoconcha dominicensis* (Des Moulins), 1866:307

SYNONYMY/DIAGNOSIS: Zullo et al., 1972:71.

REFERENCE: Ross & Newman, 1973:166.

DISTRIBUTION: Haiti; Dry Tortugas; Florida; Bermuda.

*Ceratoconcha floridana* (Pilsbry), 1931:81

SYNONYMY/DIAGNOSIS: Pilsbry, 1931:81.

REFERENCES: Henry, 1954:44; Hiro, 1935a:25; Kolosváry,

1951b:294; Ross & Newman, 1973:166; Wells, 1966:86.  
 DISTRIBUTION: West coast of Florida.

*Ceratoconcha jungi* Newman & Ladd, 1974:395  
 DISTRIBUTION: Lower Miocene, Jamaica.

*Ceratoconcha krambergeri* (Baluk & Radwánski), 1967a:145  
 SYNONYMY/DIAGNOSIS: Baluk & Radwánski, 1967a:145.  
 REFERENCES: Abel, 1920:fig. 136; 1928:13; 1935:535; Baluk & Radwánski, 1967b:480; Bogsch, 1957:29; Brooks & Ross, 1960:362; Dacqué, 1921:fig. 91b; Kolosváry, 1949:111; Kramberger-Gorjanović, 1889a:50 (as *Ceratoconcha costata* n. sp.); 1889b:231; 1889c:142; Prochazka, 1893:19; Ross & Newman, 1973:166; Stromer, 1912:fig. 232d; Termier, 1953:fig. 19; Withers, 1926:5.  
 DISTRIBUTION: Miocene, Yugoslavia.

*Ceratoconcha minuta* Newman & Ladd, 1974:394  
 DISTRIBUTION: Middle Miocene, Trinidad.

*Ceratoconcha miocaenica* (Prochazka), 1893:22  
 SYNONYMY/DIAGNOSIS: Baluk & Radwánski, 1967a:138.  
 REFERENCES: Baluk & Radwánski, 1967b:479; de Alessandri, 1910:125 (as *Pyrgoma* cf. *anglicum*), Ross & Newman, 1973:167.  
 DISTRIBUTION: Miocene, Austria and Yugoslavia.

*Ceratoconcha noszkyi* (Kolosváry), 1949:114.  
 REFERENCES: Baluk & Radwánski, 1967b:476; Kolosváry, 1949:114 (as *Andromacheia noszkyi* n. sp.); 1951b:295; Ross & Newman, 1973:167.  
 DISTRIBUTION: Miocene, Hungary.

*Ceratoconcha prefloridana* (Brooks & Ross), 1960:355  
 REFERENCES: Baluk & Radwánski, 1967b:484; Weisbord, 1972:60 (as *Creusia neogenica* n. sp.).  
 DISTRIBUTION: Pliocene, Florida.

*Ceratoconcha quadratoradiata* Newman & Ladd, 1974:393  
 DISTRIBUTION: Middle Miocene, Trinidad.

*Ceratoconcha quarta* (Kolosváry), 1947d:427  
 SYNONYMY: Ross & Newman, 1973:167.  
 DIAGNOSIS: Darwin, 1854b:378 (as *Creusia spinulosa* var. 4).  
 REFERENCE: Utinomi, 1949a:35; 1962:231.  
 DISTRIBUTION: West Indies.

*Ceratoconcha rangi rangi* (Des Moulins), 1866:302  
 SYNONYMY: Ross & Newman, 1973:167.  
 DIAGNOSIS: Des Moulins, 1866:302.  
 REFERENCES: Kolosváry, 1949:111 (as *Creusia spinulosa* forma *praespinulosa* n. f., figs 2, 3 only; and *Creusia spinulosa* forma *cladangiae* n.f., both from Hungarian Miocene); 1962a:86; 1967b:393; Prochazka, 1893:18 (as *Creusia fuchsii* n. sp.); Seguenza, 1873:319 (as *Pyrgoma multicostatum* n. sp.); Withers, 1953:57, 58, 68.  
 DISTRIBUTION: Miocene, France, Hungary and Bulgaria.

*Ceratoconcha rangi latum* (Seguenza), 1876:321  
 REFERENCE: Ross & Newman, 1973:167.  
 DISTRIBUTION: Miocene, Italy.

*Ceratoconcha sanctacrucensis* (Baluk & Radwánski), 1967b:468  
 SYNONYMY: Ross & Newman, 1973:167.  
 DIAGNOSIS/REFERENCE: Baluk & Radwánski, 1967b:468 (as *Creusia sanctacrucensis* n. sp.).  
 DISTRIBUTION: Miocene, Poland.

*Ceratoconcha sturi* (Prochazka), 1893:15  
 REFERENCE: Baluk & Radwánski, 1967b:479; Ross & Newman, 1973:167.  
 DISTRIBUTION: Miocene, Czechoslovakia.

*Ceratoconcha trolli* (Abel), 1927:101  
 REFERENCE: Abel, 1928:13.  
 DISTRIBUTION: Miocene, Austria.

### Subfamily Bosciinae n. subfam.

#### Genus *Boscia* Ferussac, 1822

*Boscia anglica* (Sowerby), 1823:no pagination  
 SYNONYMY: Darwin, 1854b:360.  
 DIAGNOSIS: Broch, 1927:30.  
 REFERENCES: Baluk & Radwánski, 1967c:693; Barnes & Klepal, 1971:88 (pedicel of penis); Bassindale, 1964:43;

Crisp & Southward, 1961:271 (cirral activity); Darwin, 1854a:36; de Alessandri, 1895:297; 1906:320; Fischer, 1872:433; Gauld, 1957:10; Gruvel, 1905a:302; Hiro, 1935a:9; 1937c:467; Hoek, 1875:60; 1909:271; 1913:257; Holdsworth, 1860:711; Kruger, 1940:460; Le Reste, 1965:66 (larvae); Moyse, 1960:120 (rearing); 1961:371 (larval stages); 1971:125 (settlement and growth); Nilsson-Cantell, 1938b:66; O'Riordan, 1967:294; Pilsbry, 1916:292; Rees, 1962:411; Relini, 1969:177; Ross & Newman, 1973:164 (= *Pyrgoma stokesii* Gray, 1825:103); Seguenza, 1876:314; Stubbings, 1964a:111; 1967:294; Utinomi, 1958a:309; Weltner, 1897:255; 1898b:11; Withers, 1953:39 et seq.  
 DISTRIBUTION: England and Ireland; France; Sicily; Madeira; Cape Verde Is.; West Africa; sublittoral to 450m. Pliocene, England; Plio-Pleistocene, Italy, Malta.

*Boscia madreporeae* (Bosc), 1812:66  
 SYNONYMY: Ross & Newman, 1973:164.  
 DIAGNOSIS: Darwin, 1854b:361.  
 REFERENCES: Gruvel, 1905a:303; 1912a:350; Hiro, 1935a:25; Kruger, 1940:382; Pilsbry, 1916:262; Southward 1975:18; Utinomi, 1967:232.  
 DISTRIBUTION: West Indies.

*Boscia oulastreae* (Utinomi), 1962:227  
 SYNONYMY: Utinomi, 1967:229.  
 DIAGNOSIS: Utinomi, 1962:227.  
 REFERENCES: Utinomi, 1949a:35 (as *Creusia spinulosa* forma *quarta*); 1967:229 (as *Megatrema oulastrea*) Utinomi & Kikuchi, 1966:8; Ross & Newman, 1973:164; Sakakura, 1934:578.  
 DISTRIBUTION: Tanabe Bay, Japan; Pleistocene, Japan.

*Boscia seguenzai* (Baluk & Radwánski), 1967c:691  
 REFERENCE: Baluk & Radwánski, 1967c:691 (as *Pyrgomina seguenzai*); Ross & Newman, 1973:164.  
 DISTRIBUTION: Pliocene, Crete.

### Family Balanidae Leach, 1817

#### Genus *Balanus* Da Costa, 1778 Group of *Balanus balanus*

*Balanus balanus* (Linnaeus), 1758:667  
 SYNONYMY/DIAGNOSIS: Pilsbry, 1916:149 (= *Balanus porcatus* da Costa, 1778:249; includes pre-Darwinian references).  
 REFERENCES: Aurivillius, 1898a:30; Ballowitz, 1908:421 (sperm); Barnes, 1953a:141 (orientation and aggregation); 1953c:128 (effect of parasitism); 1955a:114 (hatching); 1959a:232 (stomach contents); 1962a:353 (oxygen uptake and metabolism); 1963b:587 (seminal plasma); 1965:321 (biochemistry of eggs); Barnes & Barnes, 1954:63 (biology); 1965a:391 (variation in egg size); 1968a:135 (variation in egg production); 1969b:36 (seasonal changes in oxygen consumption); 1974:197 (embryonic development and salinity); Barnes & Blackstock, 1974:35 (constituents of body fluids); 1974b:47 (composition of seminal plasma); Barnes & Costlow, 1961:59 (larval stages); Barnes & Dawson, 1966:263 (lipids); Barnes & Finlayson, 1962:98 (ascorbic acid in semen); 1963:185 (seasonal changes); Barnes & Healy, 1969:51 (biometrical studies); Barnes et al., 1970:70 (effect of impaction); 1971:173 (spermatozoa); Bassindale, 1964:39; Belyaev, 1949:902; Bertelsen, 1937:38 (as *B. crenatus* according to Stephensen, 1943); Bousfield, 1955b:766; Brattstrom, 1957:12; Brocchi, 1814:598; Broch, 1924a:73; 1927b:21; 1936:3 (as *B. b. artica*); Chilton, 1909:670 (as *B. porcatus*, Auckland Is. and Australia); 1920:53 (as *B. porcatus*); Cornwall, 1955a:32; 1955b:25 (= *B. b. pugetensis* Pilsbry, 1916:163); Crisp, 1954:473 (breeding); 1964a:193 (effect of severe winter); Crisp & Patel, 1969:284 (control of breeding); Crisp & Southward, 1961:271 (cirral activity); Crisp & Spencer, 1958:290 (control of hatching); Darwin, 1854a:21; 1854b:256; Davadie, 1963:68; Dawson & Barnes, 1966:249 (biochemistry of eggs); de Alessandri,

1895:290; 1906:304; Filhol, 1885:487; Foster, 1970:390 (acclimation to salinity); Gruvel, 1903b:137; 1905a:237; 1920:54 (as *B. crenatus* according to Stephensen, 1943); Gutman, 1961:171 (colonization); Henry, 1942:101 (as *B. b. pugetensis* Pilsbry); Hiro, 1935c:227; Hoek, 1875:60; 1909:271; Hutton, 1879:328; Jennings, 1918:61; Kolosváry, 1943a:89; 1967b:391; Korschelt, 1933:23; Kruger, 1911a:3; 1911b:460; 1927a:14; 1927b:5; Linnaeus, 1767:1107; Menesini, 1966:124; Moore, 1934a:101 (growth rate); Mørch, 1852:68; Munn & Barnes, 1970a:277 (spermatozoa); 1970b:261 (spermatozoa); Nilsson-Cantell, 1931a:113; O'Riordan, 1967:293; Patel & Crisp, 1960b:104 (rate of embryonic development); 1961:89 (breeding and molting); Pilsbry, 1916:11 (*Protobalanus*, not a barnacle); 1916:149; Poulsen, 1936:13; Remy, 1928:231 (as *B. crenatus* according to Stephensen, 1943); Ruedemann, 1918:382 (*Eobalanus*, not a barnacle); Rzhepishevskii, 1968:38; Schafer, 1952:238 (settling); Sommer, 1972a:271 (motor activity); 1972b:177 (periodicity); 1972c:1449 (mechanisms of pressure sensitivity); 1972d:352 (physiology of pressure perception); Southward, 1957:327 (behavior); 1965:442 (metabolism and survival at high temperatures); Southward & Crisp, 1963:31 (fouling); Stephensen, 1938:4; 1943:18; Sumner, 1911:128; Tarasov, 1932:60; 1936:46; 1937:40; Tarasov & Zevina, 1957:194; Visscher, 1928b:193 (fouling); Weltner, 1897:267; 1898b:12; 1900:303; Zevina & Tarasov, 1964:239; Zullo, 1963b:10; 1968:6; 1969b:351.

**DISTRIBUTION:** North Atlantic and North Pacific; low water to 180m. Pliocene: England and Italy; Pleistocene: Oregon, Maine, Canada, Sweden, and Iceland.

#### *Balanus crenatus* Brugiere, 1789:168

**SYNONYMY/DIAGNOSIS:** Cornwall, 1925:476; Pilsbry, 1916:165 (includes pre-Darwin references not listed below).

**REFERENCES:** Abel, 1926:250; Addicott, 1966:C4; Aurivillius, 1898b:30; Austin et al, 1958:497 (chromosome number); Barnard, 1924:70; Barnes, 1950:74 (larvae); 1952:53; 104 (effect of light); 1953b:328 (effect of lowered salinity); 1953e:297 (variations in cyprids); 1959a:231 (stomach contents); Barnes & Bagenal, 1951b:369 (on *Nephrops norvegicus*); Barnes & Barnes, 1965a:391 (egg/nauplius size variation); 1974:194 (embryonic development and salinity); Barnes & Crisp, 1956:631 (self-fertilization); Barnes & Healy, 1969:51 (biometrical studies); Barnes & Klepal, 1971:83 (pedicel of penis); Barnes & Powell, 1950a:175 (development, morphology); 1953a:107 (growth under submersion); Barnes et al, 1951:227 (orientation); 1963:233 (effect of dessication); 1970 (behavior or impaction); 1971:173 (spermatozoa); Bassindale, 1964:38; Belyaev, 1949:902 (osmoregulation); Bishop et al, 1957:6; Blom & Nyholm, 1961:153 (settling times); Bocquet-Védrine, 1970a:506 (cement glands); 1970b:963 (cement glands); 1970c:521 (cement glands); Bohart, 1929:353 (attachment of cyprids); Bousfield, 1954:119; 1955a:19; 1955b:764; Brattstrom, 1957:10; Broch, 1922:321; 1924:78; 1927b:22; 1936:4; Chilton, 1920:53; Ciurea et al, 1933:6; Cornwall, 1925:476; 1951:329; 1955a:25; 1955b:28; Crisp, 1955:569 (behavior of cyprids); 1964a:181 (effects of severe winter); Crisp & Barnes, 1954:142 (orientation and settlement); Crisp & Patel, 1958:1078 (breeding and ecdysis); 1969:283 (environmental control of breeding); Crisp & Southward, 1961:271 (cirral activity); Crisp & Stubbings, 1957:179 (orientation to water currents); Darwin, 1854a:23; 1854b:261; Davadie, 1963:63; de Alessandri, 1906:305; 1907b:284; Ellis & Solander, 1786:198 (as *Balanus clavatus*); Fischer-Piette, 1930:41; 1932:8; Fischer-Piette & Prenant, 1956:12; Foster, 1969:326 (temperature tolerance); 1970:386 (salinity); 1971a:12 (desiccation); Gruvel, 1903b:139; 1905a:240; 1909b:25; Henry, 1942:105; 1954:443; Herz, 1933:432 (morphology of later stages); Hiro, 1935c:219; Hoek, 1875:35; 1884:517; 1909:270; Jennings, 1918:61; Kauri, 1962:131 (nauplius eye); 1966:115 (X-organ); Knight-Jones, 1955:266; Knight-Jones & Crisp, 1953:1109 (gregarious-

ness); Kolosváry, 1943a:89; 1951c:411; 1956:187; 1959:197; 1962a:85; 1963a:174; 1967b:392; Kruger, 1911a:52; 1911b:460; 1927:17; 1940:464; Kuhl, 1963:99; 1965:121; 1967:967 (ecology in Elbe estuary); Lecointre, 1910:139; Meadows, 1969a:278 (fouling); 1969b:65 (settlement, growth and competition); Moore, 1934a:101; 1936:703; Moyse, 1963:175; Muller, 1940:113 (sensitivity to poisons); Nilsson-Cantell, 1921:326; 1931a:113; O'Riordan, 1967:291; Patel & Crisp, 1960b:104 (embryo development); 1961:89 (relationship between breeding and moulting); Pilsbry, 1911a:75; 1921:112; Poulsen, 1935:21; Prenant & Teissier, 1923:176; Pyefinch, 1948a:451; 1948b:464; 1948c:916 (larvae); Schäfer, 1938b:323 (paleontology); 1952:242 (settling); Schwarz, 1932:437 (influence of light); Sneli, 1972:3; Southward, 1955b:403 (relation of activities to temperature); 1965:443 (metabolism and survival); Southward & Crisp, 1963:36; 1965:161 (activity rhythms); Stebbing, 1910:569; Stephensen, 1938:5; 1943:19; Stubbings, 1961b:33; Tarasov, 1936:48; 1937:50; Tarasov & Zevina, 1957:205; Trusheim, 1932:70 (paleontology); Utinomi, 1970:358; Walker, 1972:429 (chemical composition of cement); Weltner, 1897:268; 1898a:442; 1898b:11; 1900:298; Withers, 1953:58, 61, 70; Zevina & Tarasov, 1964:239; Zullo, 1963b:10; 1969b:315.

**DISTRIBUTION:** North Pacific, south to Santa Barbara; Arctic; North Atlantic south to Florida. Unverified localities: S. Africa, Australia, West Indies, Peru, southern China; intertidal to 250m. Oligocene to Pliocene, Mediterranean Basin; Pleistocene, North America.

#### *Balanus crenatus curviscutum* Pilsbry, 1916:175

**SYNONYMY/DIAGNOSIS:** Pilsbry, 1916:175.

**REFERENCES:** Henry, 1942:126; Hiro, 1935c:221; Utinomi, 1958a:308.

**DISTRIBUTION:** North Pacific; Japan to Northwest America.

#### *Balanus crenatus delicatus* Pilsbry, 1916:177

**REFERENCE:** Henry, 1942:126.

**DISTRIBUTION:** Humboldt Bay, California.

#### *Balanus glandula* Darwin, 1854b:265

**SYNONYMY:** Pilsbry, 1916:178.

**DIAGNOSIS:** Cornwall, 1925:438.

**REFERENCES:** Augenfeld, 1967:92 (respiration); Barnes & Barnes, 1956a:415 (biology); 1959h:515 (metabolism); 1956a:391 (variation in egg and nauplius size); Barnes & Gonor, 1958:194 (neurosecretory cells); Barnes & Healy, 1969:62 (biometrical studies); Barnes & Klepal, 1971:83 (pedicel of penis); Batzli, 1969:535 (distribution of biomass); Bergen, 1968:229; Broch, 1922:321; Connell, 1970:49 (predation by *Thais*); Cornwall, 1951:326; 1955a:27; 1955b:33; Dayton, 1971:351 (competition); Glynn, 1965:109 (*Endocladia-Balanus* associations); Gruvel, 1905a:238; Haven, 1973:97; Henry, 1942:108; Johnson & Miller, 1935:12 (settlement); Kolosváry, 1943a:91; Newman, 1967:1038 (biology); Nilsson-Cantell, 1921:326; Pilsbry, 1907d:201; Rice, 1930:249 (distribution in communities); Tarasov & Zevina, 1957:202; Weltner, 1897:269; 1898b:7; Worley, 1939:233 (correlation between salinity, size and abundance); Zullo, 1969b:351.

**DISTRIBUTION:** Aleutians to Baja California; Rio de Janeiro (Spivak, in litt.). Pleistocene, Oregon.

#### *Balanus withersi* Pilsbry, 1930:429

**DISTRIBUTION:** Miocene, New Jersey.

### Group of *Balanus nubilus*

#### *Balanus connelli* Cornwall, 1927b:402

**DISTRIBUTION:** Miocene, British Columbia.

#### *Balanus nubilus* Darwin, 1854b:253

**SYNONYMY/DIAGNOSIS:** Ross, 1962:24; Henry, 1942:112.

**REFERENCES:** Abel, 1926:246; Addicott, 1966c:4; Arvy and Lacombe, 1968:1326 (cement apparatus); Arvy & Ligouri, 1968:817 (muscular cytochrome oxidase activity); Arvy et al, 1968:817 (alkaline phosphatase activity); Barnes, 1959a:234 (stomach contents); 1959b:607 (note on spelling of *nubilus*); Barnes & Barnes, 1959b:19 (stimulation

of nauplii); 1959c:15 (naupliar stages); 1965a:391 (variation in egg, nauplius size); Barnes & Gonor, 1958:194 (neurosecretory cells); Carderelli, 1968:1 ( barnacle cement); Cornwall, 1925:479; 1927b:408; 1936:471 (as *Balanus altissimus*); 1951:334 (as *Balanus flos*, 335; 1953:78, 80; 1955a:23; 1955b:36; 1958:81; 1959:404; Emerson & Hertlein, 1960:7; Fitzgerald, 1968:1055 (calcium and pH dependency); Gruvel, 1903b:130; 1905a:226; Hagiwara & Nakajima, 1966:807 (effects of Ca ion concentration); Hagiwara & Takahashi, 1967:583 (surface density of calcium in muscle fiber); Hagiwara et al, 1968:773 (effects of pH changes); Harnden, 1968:303 (digestive carbohydrates); Hatai, 1938:96; Henry, 1940:29; Hoyle & Smythe, 1963:49 (giant muscle fibers); Hughes, 1914:213; Kaminer & Kimura, 1972:406 (calcium release in muscle); Kolosváry, 1943a:89; 1959:197; Kruger, 1940:464; Lacombe, 1970:164 (cement glands); Nilsson-Cantell, 1931a:112; Pilsbry, 1907d:201 (as *Balanus flos* n. sp.); 1916:131, 135; 1921:112; Shelford et al, 1935:281; Tait & Emmons, 1925:42 (movement of operculum); Whitney, 1970:229 (sterol biosynthesis); Zullo, 1969a:8; 1969b:351.

DISTRIBUTION: Southern Alaska to San Quintin, Baja California. Oligocene, Vancouver Is., B.C.; Miocene, Japan and Hungary; Plio-Pleistocene, southern and Baja California; Pleistocene, Oregon.

#### *Balanus rostratus* Hoek, 1883:152

SYNONYMY: Cornwall, 1955b:38.

DIAGNOSIS: Pilsbry, 1916:138 (as *B. r. rostratus*), 141 (as *B. rostratus alaskensis* n. subsp.), 142 (as *B. rostratus heteropus* n. subsp.), 147 (as *B. rostratus dalli* n. subsp.).

REFERENCES: Addicott, 1966:C4; Barnes, 1959a:233; Barnes & Barnes, 1959h:515; Barnes & Gonor, 1958:194 (neurosecretory cells); Barnes & Klepal, 1971:83 (pedicel of penis); Broch, 1922:320; Cornwall, 1925:484; 1955a:29; Gruvel, 1905a:239; Hatai, 1938:97; Henry, 1940:21; 1942:117, 127 (as *apertus* and *dalli*); Hiro, 1932a:550; 1933:71; 1935c:217, 218 (as *apertus*), 227 (as *apertus*); 1939f:210, 211 (as *dalli*); Kolosváry, 1943a:89 (as *dalli*); 1961a:78; 1962b:210; 1962d:202; 1967b:392; Kruger, 1911a:52; 1911b:463 (as *apertus*); 1940:464; Nilsson-Cantell, 1932a:20 (as *spiniferus*); Pilsbry, 1911a:73, 74 (as *B. r. apertus* n. subsp.); 1916:144 (as *apertus*), 147 (as *dalli*), 148 (as *B. rostratus dalli* form *suturalis*); Tarasov & Zevina, 1957:199, 200, 201 (as *apertus*), 202 (as *dalli*); Utinomi, 1958a:294, 295 (as *apertus*); 1969b:51; 1970:357; Weltner, 1897:269; 1900:296; Yamaguchi, 1971:122; Zullo, 1969b:351 (as *B. rostratus apertus*).

DISTRIBUTION: Japan; Siberia; Bering Sea; Alaska and Puget Sound; 0-128m. Miocene, USSR and Japan; Pleistocene, Central California, Oregon and Japan.

#### *Balanus tamiamiensis* Ross, 1964b:272

DISTRIBUTION: Miocene, Florida.

#### Group of *Balanus concavus*

##### *Balanus aquila* Pilsbry, 1907a:199

SYNONYMY/DIAGNOSIS: Pilsbry, 1916:127.

REFERENCES: Baskin et al, 1969:471 (filaments from myosin); Cornwall, 1951:333; 1960:831; Henry, 1942:100; Zullo, 1966c:141.

DISTRIBUTION: San Francisco to San Diego, California; intertidal to 18m.

##### *Balanus bloxhamensis* Weisbord, 1966:48

DISTRIBUTION: Miocene, Florida.

##### *Balanus concavus concavus* Brönn, 1831:127

SYNONYMY/DIAGNOSIS: Menesini, 1965:110; Utinomi, 1969a:83.

REFERENCES: Arnold, 1907a:543; 1907b:422; Beal, 1948:64; Darwin, 1854a:17; 1854b:235; Davadie, 1963:52; Davadie-Suaudeau, 1952:17; de Alessandri, 1895:282; 1906:295; 1907b:280; DeLong, 1941:243; Emerson & Hertlein, 1960:7; Gruvel, 1903b:136; 1905a:232; Kolosváry, 1943a:85; 1955:183; 1959:197; 1960:590; 1961a:78; 1961b:99; 1961c:150; 1962b:206; 1962d:202; 1967b:391; Menesini, 1963:5; 1966:116; 1967b:219; 1968b:580; 1972:40; Nilsson-

Cantell, 1939a:6; Nomland, 1917:301; Pilsbry, 1916:100; Ross, 1962:14; 1964a:489; Sequenza, 1876:296; Utinomi, 1969a:83 (includes *Balanus concavus sinensis* Broch, 1931:63 and *B. c. indicus* Nilsson-Cantell, 1932b:2); Weaver, 1949:104; Weisbord, 1966:32; Weltner, 1897:264; Zullo, 1969a:6.

DISTRIBUTION: China; India; Persian Gulf. Oligocene-Pleistocene, Mediterranean Basin; Miocene, Eastern United States and Britain; Pliocene, Venezuela.

##### *Balanus concavus alloplax* Pilsbry & Olson, 1951:200

DISTRIBUTION: Oligocene, Ecuador.

##### *Balanus concavus eschapekensis* Pilsbry, 1916:103

SYNONYMY/DIAGNOSIS: Pilsbry, 1916:103.

REFERENCES: Kolosváry, 1943a:85; Martin, 1904:94.

DISTRIBUTION: Miocene, Maryland.

##### *Balanus concavus coosensis* Dall, 1909:138

SYNONYMY/DIAGNOSIS: Pilsbry, 1916:108 (= *B. tintinnabulum coosensis* Dall).

DISTRIBUTION: Miocene, Coos Bay, Oregon.

##### *Balanus concavus dallonii* Davadie-Suaudeau, 1952:20

DISTRIBUTION: Pliocene, Algeria.

##### *Balanus concavus eseptatus* Pilsbry, 1924:1

DISTRIBUTION: Miocene, Haiti.

##### *Balanus concavus finchi* Lea 1833:211

SYNONYMY: Pilsbry, 1930:432.

DISTRIBUTION: Miocene, Maryland.

##### *Balanus concavus glyptopoma* Pilsbry, 1916:102

REFERENCE: Cones, 1968:61; Kolosváry, 1943a:85. Pilsbry, 1918:185.

DISTRIBUTION: Miocene, eastern United States. Pliocene, Panama and east Mexico.

##### *Balanus concavus mexicanus* Henry, 1941:100

REFERENCES: Henry, 1942:126; 1960:141.

DISTRIBUTION: West coast of Baja California to Mazatlan, Mexico.

##### *Balanus concavus oligoseptatus* Kolosváry, 1961c:149

DISTRIBUTION: Upper Oligocene, U.S.S.R.

##### *Balanus concavus proteus* Conrad, 1834:134

SYNONYMY/DIAGNOSIS: Ross, 1964a:486.

REFERENCES: Davadie, 1963:53; Kolosváry, 1943a:86; Pilsbry, 1916:103.

DISTRIBUTION: Mio-Pliocene, eastern United States.

##### *Balanus concavus raphanoides* Moroni-Ruggieri, 1952:71

DISTRIBUTION: Pliocene, Italy.

##### *Balanus concavus rariseptatus* Pilsbry, 1918:186

DISTRIBUTION: Miocene, Panama.

##### *Balanus concavus rubescens* Seguenza, 1876:450

DISTRIBUTION: Tertiary, Italy.

##### *Balanus concavus scutorum* Seguenza, 1876:74

SYNONYMY/DIAGNOSIS: Moroni-Ruggieri, 1952:67.

REFERENCE: de Alessandri, 1906:292 (as *Balanus spongicola*).

DISTRIBUTION: Pliocene, Italy.

##### *Balanus concavus sinensis* Broch (see *B. c. concavus*)

##### *Balanus eyerdami* Henry, 1960:139

REFERENCE: Ross, 1962:17.

DISTRIBUTION: Gulf of California; 0-85m.

##### *Balanus gregarius* (Conrad), 1856:315

SYNONYMY/REFERENCES: Zullo, 1969a:6 (includes *Tamiosoma gregaria*, *Radiolites gregaria*, *Balanus estrellanus* and *Balanus concavus concavus*, Ross, 1962:14).

DISTRIBUTION: Mio-Pliocene, Central and Southern California; Pliocene, Baja California.

##### *Balanus indicus* Withers, 1923:291

DISTRIBUTION: Miocene, Pakistan.

##### *Balanus polyporus* Pilsbry, 1924:2

DISTRIBUTION: Miocene, Haiti.

##### *Balanus regalis* Pilsbry, 1916:108

SYNONYMY/DIAGNOSIS: Ross, 1962:19.

REFERENCES: Cornwall, in Steinbeck & Ricketts, 1941:430; Cornwall, 1959:403; Henry, 1942:100; 1943:368; 1960:144 (as subsp. of *B. aquila*); Kolosváry, 1942c:139; 1943a:85.

DISTRIBUTION: Southern and Baja California.

##### *Balanus talquinensis* Weisbord, 1966:37

DISTRIBUTION: Miocene, Florida.

*Balanus vudaszi* Kolosváry, 1949a:2  
 REFERENCE: Davadie, 1963:57; Menesini, 1972:42.  
 DISTRIBUTION: Miocene, Europe.

Group of *Balanus amphitrite*

*Balanus albicostatus albicostatus* Pilsbry, 1916:90

SYNONYMY/DIAGNOSIS: Utinomi, 1967:209.

REFERENCES: Gravel, 1903b:133 (as *Balanus violaceus*); 1905a:227; Hirano, 1953:1 (rearing); Hirano & Okushi, 1952:639 (attachment and growth rate); Hiro, 1937c:432; 1938a:303; 1938c:1687 (resistance to exposure); 1939a:128; 1939e:261; 1939f:209; Hudinaga & Kasahara, 1942:108; Ishida & Yasgui, 1937:1659 (free-swimming stages); Kawahara, 1961:70 (fouling); Kawahara & Iizima, 1960:584 (fouling); Kolosváry, 1943a:84; 1951c:411; 1961b:100; 1961c:150; 1962c:202; 1967b:391; Kruger, 1911a:51 (as *Balanus amphitrite communis*); Mawatari, 1967:99 (fouling); Mawatari et al, 1962:93; 1963:95 (water conduit fouling); Nilsson-Cantell, 1921:314; Nishikawa, 1960:355 (chromosomes); Ooishi, 1964:195; Pilsbry, 1916:90 (as *Balanus amphitrite albicostatus*); Stubbing, 1967:277; Tarasov & Zevina, 1957:183; Utinomi, 1949a:22; 1955b:124 (geology); 1958a:308; 1958b:51; 1962:216; 1969b:52; 1970:356; Utinomi & Kikuchi, 1966:5; Zevina & Tarasov, 1963:91.

DISTRIBUTION: Japan; China; Formosa; Korea. Miocene; Turkistan, U.S.S.R.

*Balanus albicostatus formosanus* Hiro, 1938a:306

SYNONYMY/DIAGNOSIS: Utinomi, 1967:212.

REFERENCES: Hiro, 1939e:261; Kolosváry, 1961b:100; 1962:d:199; 1967b:391.

DISTRIBUTION: Formosa; Miocene, U.S.S.R.

*Balanus amphitrite abundantus* Kolosváry, 1948:106

DISTRIBUTION: Miocene, Hungary.

*Balanus amphitrite amphitrite* Darwin, 1854b:240

SYNONYMY: Utinomi, 1967:200; Southward, 1975:6.

DIAGNOSIS: Harding, 1962:274; Stubbing, 1967:271. (Includes *communis* Darwin, *denticulata* Broch, *hawaiensis* Broch, *carenatus* Gruvel, *franciscanus* Rodgers, *herzi* Rodgers, *saltonensis* Rodgers).

REFERENCES: Annandale, 1907:40; 1911:170 (growth rate); 1915:138; Ball, 1937:534; 1950:283; Barnard, 1924:69; Barnes & Barnes, 1959f:438 (oscillatory respiration); 1965a:392 (variation in egg/nauplius size); 1968a:146 (variation in egg numbers); Barnes et al, 1970:70 (impaction); 1971:173 (spermatozoal); Bassindale, 1964:40; Bhatt & Bal, 1960:439; Bishop, 1950:409; Bishop et al, 1957:8; Bookhout & Costlow, 1959:212 (feeding, molting, growth); Borghouts-Biersteker, 1969:4; Borradaile, 1903:441; Broch, 1916:5; 1922:314; 1924b:203; 1927d:133; 1931:58; 1935:2; Callame, 1965:413 (effect of light); Ciurea et al, 1963:6; Costlow & Bookhout, 1956:107 (as *B. a. niveus* — moulting and shell growth); 1958a:284 (larval development); 1958b:271 (moulting and respiration); Crisp & Costlow, 1963:22 (embryo tolerance to salinity and temperature); Crisp & Molesworth, 1951:489; Crisp & Southward, 1961:271; Daniel, 1955c:20; Darwin, 1854b:493 (= *B. pictus* Münster); Davadie, 1963:44; Davis et al, 1973:310 (interval cycle); Day & Morgans, 1956:303; de Alessandri, 1895:286; 1906:301; 1907b:282; de Oliveira, 1941:17; 1947:733; DePalma, 1963:15; Edmondson & Ingram, 1939:257; Fahrenbach, 1965:233 (photoreceptors); Filhol, 1885:486; Fischer, 1929:10; Fischer, 1872:432; Fischer-Piette & Prenant, 1956:15; Fishelson, 1971:128; Foster, 1967a:83; Freiberger & Cologer, 1966:881 (rearing in laboratory); Gordon, 1970:69; Graham & Gay, 1945:381 (attachment and growth); Gruvel, 1903b:137; 1905a:232; 1907d:6; 1912a:346; Henry, 1958:222; 1959:192; 1960:142; 1973:968; Hirano, 1953:139 (rearing); 1962:77 (rearing); Hirano & Okushi, 1952:639 (seasonal variation in attachment and growth rate); Hiro, 1933:71; 1936a:59 (commensalism); 1936b:624; 1937c:432; 1938a:301; 1938c:1687; 1939c:590; 1939e:263; 1939f:208; Hoek, 1913:172; Hudinaga &

Kasahara, 1942:108 (rearing); Karande, 1967:1245 (fouling); 1973:56 (larvae); 1974b:229 (larval comparison with *B. variegatus*); Karande & Palekar, 1966:143; Karande & Thomas, 1971:109 (laboratory rearing); Kawahara, 1961:67 (fouling); Kawahara & Iizima, 1960:584 (fouling); Kolosváry 1939b:129; 1941i:173 (as *B. pictus*); 1943a:83; 1943c:129; 1944:33; 1947c:424; 1947d:425; 1951b:292; 1959:197; 1961a:78; 1961b:100; 1961c:150; 1962b:205; 1962d:202; 1963a:173; 1963b:175; 1967b:391; Kruger, 1911a:51; 1911b:460; 1940:464; LaCombe, 1970:164 (cement glands); LaCombe & Monteiro, 1974:633; Lanchester, 1902:369; LeReste, 1965:65; Mawatari, 1970:80 (fouling); Mawatari et al, 1954a:46 (settlement and growth); 1954b:48 (settlement and growth); 1962:91 (fouling); 1963:93 (fouling); 1968:24 (propagation by ships); Mawatari & Kitamura, 1970:67 (fouling); Mawatari & Kobayashi, 1954a:37 (fouling); 1954b:1 (fouling); Menesini, 1965:102; Millard, 1950:266; Millard & Broekhuysen, 1970:299; Monod, 1937:15; Moore & Frue, 1959:431; Moore, 1944:333; Moyse, 1960:120; Newman, 1967:1038 (biology); Newman et al, 1967:170; Nilsson-Cantell, 1921:311; 1930b:10; 1931a:122; 1934b:32; 1938b:36; 1949:43; Norris et al, 1951:444 (variability in larval stages); Patel & Crisp, 1960a:667 (influence of temperature); Pillai, 1958:117 (development); Pilsbry, 1907c:190; 1916:89 (= *B. crenatus* Gruvel, 1907d:6); 1928:312; Pope, 1945:362; Por, 1972:112; Por & Ferber, 1972:151; Prenant, 1929:212; Prenant & Teissier, 1923:170; Relini, 1962:3; 1964:408; 1966:179; 1968b:186; 1969:169; Relini & Giordano, 1969:251 (vertical distribution); Riedl, 1963:257; Ritz & Foster, 1968:545 (temperature responses); Rogers, 1949:5; Rosell, 1973b:82 (as *B. a. hawaiiensis*); Ross, 1962:12; Sandison, 1954:86; Seguenza, 1876:300; Shatoury, 1958:790; Southward, 1957:323 (influence of temperature); 1962:163 (influence of temperature); Southward & Crisp, 1963:27 (fouling); Stebbing, 1910:568; Stubbing, 1936:41; 1961a:173; 1961b:22; 1963b:14; 1965:886; Suzuki & Konno, 1970:9 (fouling); Tarasov & Zevina, 1957:179; Utinomi, 1949a:22; 1950:63; 1955b:125; 1958a:308; 1960:43 (synonymy of *hawaiiensis* and *denticulata*); 1962:215; 1969a:86; 1969b:52; 1970a:355; Utinomi & Kikuchi, 1966a:5; Visscher, 1928a:327; 1928b:193 (fouling); Visscher & Luce, 1928:336 (reaction to light); Weiss, 1947a:56 (tolerance to copper and mercury); 1948:116 (abnormal growth); Wells, 1966:83; Wells et al, 1964:567; Weltner, 1887:102; 1897:264; 1910:528; Wisely & Blick, 1964:163 (seasonal abundance of larvae); Withers, 1923:290; 1924:32; Yasuda, 1968:27 (fouling); Zevina, 1963:73; Zevina & Litvinova, 1970:173; Zullo, 1963b:8, 9 (*B. amphitrite* subsp. n. = *B. improvisus* Darwin according to Henry, 1973:968).

DISTRIBUTION: Cosmopolitan, in warm and temperate seas. Numerous Fossils attributed to this species; Oligocene to Pleistocene.

*Balanus amphitrite acutus* Withers, 1924:30

DISTRIBUTION: Miocene, New Zealand (Withers, 1953:77 et seq.).

*Balanus amphitrite aeratus* deOliveira, 1941:22

DISTRIBUTION: Rio de Janeiro.

*Balanus amphitrite archi-inexpectatus* Kolosváry, 1948:108

DISTRIBUTION: Miocene, Hungary.

*Balanus amphitrite cochinensis* Nilsson-Cantell, 1938b:43

REFERENCES: Karande, 1966:144; 1967:1245.

DISTRIBUTION: Bombay.

*Balanus amphitrite columbianus* Tarasov & Zevina, 1957:184

DISTRIBUTION: Vladivostok, on Japanese Fishing boat.

*Balanus amphitrite fluminensis* deOliveira, 1941:21

DISTRIBUTION: Rio de Janeiro.

*Balanus amphitrite helena* Kolosváry, 1949a:7

DISTRIBUTION: Miocene, Turkistan.

*Balanus amphitrite hungaricus* Kolosváry, 1948:108

DISTRIBUTION: Miocene, Hungary.

*Balanus amphitrite inexpectatus* Pilsbry, 1916:97

SYNONYMY/DIAGNOSIS: Henry, 1943:368.

- REFERENCES: Davadie, 1963:44; Henry, 1942:126; 1959:199; 1960:142; 1973:983; Kolosváry, 1943a:84; 1947a:20; 1951c:411; 1967b:391; Nilsson-Cantell, 1933:506; 1939a:3; Tarasov & Zevina, 1957:187.
- DISTRIBUTION: Gulf of California; Bonaire; Red, Adriatic, and Mediterranean Seas, (Kolosváry). Pliocene, Florida.
- Balanus amphitrite insignis* Nilsson-Cantell, 1938b:41
- REFERENCE: Karande, 1966:145; 1967:1245.
- DISTRIBUTION: Bombay.
- Balanus amphitrite karakumiensis* Kolosváry, 1961b:100
- DISTRIBUTION: Miocene, Hungary.
- Balanus amphitrite kondakovi* Tarasov & Zevina, 1957:191
- REFERENCES: Henry, 1973:991; Rosell, 1973b:88; Zevina & Tarasov, 1963:94.
- DISTRIBUTION: Mainland coast southeast Asia.
- Balanus amphitrite litoralis* Kolosváry, 1948:106
- DISTRIBUTION: Miocene, Hungary.
- Balanus amphitrite merklini* Kolosváry, 1962d:199
- DISTRIBUTION: Miocene, U.S.S.R.
- Balanus amphitrite peruvianus* Pilsbry, 1909:69
- SYNONYMY/DIAGNOSIS: Pilsbry, 1916:97.
- REFERENCES: Henry, 1973:983; Kolosváry, 1943a:84; Nilsson-Cantell, 1957:10.
- DISTRIBUTION: Costa Rica to Peru; often on mangroves.
- Balanus amphitrite poecilosculpta* Broch, 1931:59
- SYNONYMY/DIAGNOSIS: Nilsson-Cantell, 1934a:61.
- REFERENCES: Broch, 1947:5; Dawydyoff, 1952:128; Hiro, 1937c:435; Utinomi, 1958a:294.
- DISTRIBUTION: Indonesia; South China Sea; 33-85m.
- Balanus amphitrite rafflesii* Nilsson-Cantell, 1934a:64
- DISTRIBUTION: Singapore; on mangroves.
- Balanus amphitrite tongaensis* Kolosváry, 1962c:193
- REFERENCES: Kolosváry, 1967b:391.
- DISTRIBUTION: Tonga Is.
- Balanus amphitrite vladivostokensis* Tarasov & Zevina, 1957:184
- REFERENCE: Utinomi, 1967:214 (possibly a synonym of *B. variegatus cirratus*).
- DISTRIBUTION: Vladivostok.
- Balanus caboblanquensis* Weisbord, 1966:26
- DISTRIBUTION: Pliocene, Venezuela.
- Balanus caribensis* Weisbord, 1966:23
- DISTRIBUTION: Venezuela.
- Balanus citerosum* Henry, 1973:976
- REFERENCE: Southward, 1975:42 (probably equals *B. pallidus*)
- DISTRIBUTION: Rio de Janeiro to Santa Catarina.
- Balanus dentivarians* Henry, 1973:992
- DISTRIBUTION: Southwest Mexico to Ecuador.
- Balanus eburneus* Gould, 1841:15
- SYNONYMY/DIAGNOSIS: Pilsbry, 1916:80.
- REFERENCES: Arvy and LaCombe, 1968:1326 (cement apparatus); Arvy & Ligouri, 1968:817 (cytochrome oxidase activity); Arvy & Nigrelli, 1969:95 (parasites); Arvy et al, 1968:817 (alkaline phosphatase activity); 1969:351 (parasites); Bacon, 1971:187 (populations in relation to salinity); Barnes & Barnes, 1965a:391; (variation in egg and nauplius size); Barnes & Healy, 1971:83 (biometrical studies); Barnes & Klepal, 1971:81 (pedicel of penis); Barnes et al, 1951:227 (orientation); 1970:70 (impaction); 1971:188 (spermatozoa); Bartha & Henriksson, 1971:7 (anti-fouling); Bassindale, 1964:39; Belyaev, 1949:901 (osmoregulation); Bishop, 1947:501; 1951:531 (introduction to Australia); Bishop et al, 1957:4; Blom, 1965:59; Blom & Nyholm, 1961:149 (settling); Bocquet-Védrine, 1962:144; Bocquet-Védrine & Parent, 1972:239 (parasitism by *Boschmaella*); Bookhout & Costlow, 1959a:212 (feeding, molting, growth); Borradaile, 1916:132; Bousfield, 1954:120; 1955a:1 (ecological control in Miramichi estuary); Brattström, 1957:8; Broch, 1924a:81; 1924b:203; 1927c:25; 1935:2; Buchholz, 1951:49 (larvae); Carlton & Zullo, 1969:1 (early records on Pacific coast N. America); Ciurea et al, 1933:2; Costlow, 1956:359 (shell development); 1959:177 (effect of inhibitors); Costlow & Bookhout, 1953:420 (molting and growth); 1957b:224 (body vs. shell growth); Crisp, 1953:331 (changes in orientation); 1958:483; Crisp & Southward, 1961:271 (cirral activity); Davadie, 1963:61; Doochin, 1951:15 (morphology during metamorphosis); Elofsson, 1952:47; Filatowa, 1902:379 (post-embryonic development); Fischer, 1872:432; Fischer-Piette & Prenant, 1956:11; Foster, 1970:388 (acclimation to salinity); Gordon, 1969:139 (influence of salinity); Gordon et al, 1970:461 (sodium/manganese content of shell); Graham & Gay, 1945:381 (attachment and growth); Gruvel, organs); Fischer-Piette & Prenant, 1956:13; Freiberger & Cologer, 1966:881 (rearing in laboratory); Freiberger et al, 1969:469 (fouling and anti-fouling studies); Gordon, 1969:139 (influence of salinity on distribution); Gordon et al, 1970:461 (environmental influence); Grave, 1933:378 (growth rate); Gregg, 1945:44 (attachment of cyprids); 1948:161 (replication of substrate detail); Gruvel, 1903b:137; 1905a:234; Gwilliam, 1963:470; 1965:244 (shadow reflex); Henry, 1954:443 (distribution); 1959:194; 1973:968, 982; Kolosváry, 1943a:81; 1943c:129; 1944:33; 1947a:21; 1965:272; 1967b:392; Kruger, 1940:464; Lacombe, 1970:164 (cement glands); Lacombe & Monteiro, 1974:633; Matsui et al, 1964:141; Mawatari, 1967:99 (harbor fouling); McDougall, 1943:344; Moore & Frue, 1959:432 (settlement & growth); Neu, 1935b:92 (fouling); Nilsson-Cantell, 1921:309; 1928a:32; 1931a:109; 1938b:35; Ostroumoff, 1892:160; Pilsbry, 1918:185; 1924:1; Pomerate & Reiner, 1942:14 (influence of surface angle and light on attachment); Relini, 1962:3; 1964:406; 1966:179; 1968b:186; 1969:175; Relini & Giordano, 1969:250 (vertical distribution and settlement); Riedl, 1963:258; Sandeen & Costlow, 1961:192 (central nervous system); Shaw, 1972:145 (lateral eye); Shimony & Nigrelli, 1971:662 (cement apparatus); 1972:349; Smith, 1946:51 (effects of water currents); Southward, 1962:163 (temperature on cirral activity); Southward & Crisp, 1963:34; Stubbings, 1967:270; Sumner, 1911:128; Tarasov & Zevina, 1957:174; Utinomi, 1966:36; Wells, 1966:84; Weiss, 1947a:56 (tolerance to copper and mercury); 1947b:240 (attachment of cyprids); 1948:116 (abnormal development); Weltner, 1897:266; 1898b:12; Wharton, 1948:180 (primary attachment); Visscher, 1928b:193 (fouling and resistance to fresh water); Zevina, 1963:73; Zevina & Goryn, 1971:771; Zullo, 1963b:11.
- DISTRIBUTION: Endemic to western Atlantic, Boston to Rio de Janeiro; introduced to Europe, Mediterranean, Indian Ocean, Japan, Hawaii and other islands of Pacific Oceania. Miocene, Haiti; Pleistocene, Panama. Tertiary, Yugoslavia.
- Balanus hopkinsi* Zullo, 1968:4
- DISTRIBUTION: Plio-Pleistocene, Iceland.
- Balanus improvisus* Darwin, 1854b:250
- SYNONYMY/DIAGNOSIS: Henry, 1959:196.
- REFERENCES: Arbuzova, 1959:462 (permeability of basis); Barnes & Barnes, 1961b:4 (salinity and biometry); 1962:1; 1965a:391 (variations in egg and nauplius size); 1968a:135 (regional variations in egg numbers); Barnes & Healy, 1969:51 (biometrical studies); Barnes & Klepal, 1971:81 (pedicel of penis); Barnes et al, 1951:227 (orientation); 1970:70 (impaction); 1971:188 (spermatozoa); Bartha & Henriksson, 1971:7 (anti-fouling); Bassindale, 1964:39; Belyaev, 1949:901 (osmoregulation); Bishop, 1947:501; 1951:531 (introduction to Australia); Bishop et al, 1957:4; Blom, 1965:59; Blom & Nyholm, 1961:149 (settling); Bocquet-Védrine, 1962:144; Bocquet-Védrine & Parent, 1972:239 (parasitism by *Boschmaella*); Bookhout & Costlow, 1959a:212 (feeding, molting, growth); Borradaile, 1916:132; Bousfield, 1954:120; 1955a:1 (ecological control in Miramichi estuary); Brattström, 1957:8; Broch, 1924a:81; 1924b:203; 1927c:25; 1935:2; Buchholz, 1951:49 (larvae); Carlton & Zullo, 1969:1 (early records on Pacific coast N. America); Ciurea et al, 1933:2; Costlow, 1956:359 (shell development); 1959:177 (effect of inhibitors); Costlow & Bookhout, 1953:420 (molting and growth); 1957b:224 (body vs. shell growth); Crisp, 1953:331 (changes in orientation); 1958:483; Crisp & Southward, 1961:271 (cirral activity); Davadie, 1963:61; Doochin, 1951:15 (morphology during metamorphosis); Elofsson, 1952:47; Filatowa, 1902:379 (post-embryonic development); Fischer, 1872:432; Fischer-Piette & Prenant, 1956:11; Foster, 1970:388 (acclimation to salinity); Gordon, 1969:139 (influence of salinity); Gordon et al, 1970:461 (sodium/manganese content of shell); Graham & Gay, 1945:381 (attachment and growth); Gruvel,

1903b:136; 1905a:231; 1907a:105; 1912a:345; Henry, 1942:110; 1954:443 (distribution); 1973:976,992; Hiro, 1936a:61; Hoek, 1875:60; 1909:271,308; Holmes & Pryor, 1938:795; Jackson & Ross, 1971:188 (on snapping turtle); Jones & Crisp, 1954:765 (larval stages); Kauri, 1962:131 (frontal filament and nauplius eye); 1966:115 (x-organ); Kawahara, 1961:65 (differences in fouling communities); 1963b:301 (first record from Japan - Pacific side); Kolosváry, 1941a:43; 1942b:204 (as *B. i. fossilis*); 1943a:82; 1943c:129; 1951c:411; 1959:197; 1961a:78; 1962b:206; 1963a:174; 1965a:271 (fouling); 1966b:143; 1967a:388; 1967b:392; Krüger, 1927a:13; 1927b:5; 1940:464; Kuhl, 1965:120; 1967b:965 (in Elbe estuary); 1968:1 (metamorphosis); Lacombe & Monteiro, 1974:633; Luther, 1950:155; MacDonald, 1951:87; Maksimov et al., 1971:1090 (factors influencing population); Mawatari, 1967:99 (fouling); Mawatari et al., 1968:24 (propagation by ships); McDermott, 1960:199 (predation); McDougall, 1943:323; Moore, 1933:969 (orientation); Moore & Frue, 1959:421 (settlement and growth); Müller, 1868:393 ("hybrid". *B. armatus*); Neu, 1932:143; 1935b:92; Newman, 1967b:1041 (physiology and behavior); Nilsson-Cantell, 1921:310; 1927b:91; 1928a:33; 1931a:110; Norris et al., 1951:444 (variability in larval stages); O'Riordan, 1967:293; Pilsbry, 1916:84 (= *B. improvisus* var. *assimilis* Darwin, 1854b:250; = *B. improvisus* var. *graphicus* Münter, 1878); Poulsen, 1935:18; Prenant & Teissier, 1923:176; Relini, 1969:173; Schäfer, 1952:241 (settling); Schwarz, 1932:437 (influence of light); Sneli, 1972:1; Southward, 1957:325; Southward & Crisp, 1963:33; Stubbings, 1967:270; Tarasov & Zevina, 1957:168; Tengstrand, 1931:108 (larvae); Tornävä, 1948:3 ( alimentary canal); Utinomi, 1966:36; van Breeman, 1934:247 (biology); Visscher, 1928a:327 (attachment); 1928b:193 (fouling); Visscher & Luce, 1928:336 (reaction to light); Weiss, 1947a:56 (tolerance to copper and mercury); 1947b:240 (settlement); 1948:116 (abnormal development); Wells, 1966:84; Weltner, 1895:289; 1897:266; 1898a:441; 1898b:5; Zevina, 1963:73; Zevina & Goryn, 1971:771 (Sea of Japan); Zevina & Litvinova, 1970:172; Zullo, 1963b:12; 1966b:235.

DISTRIBUTION: East Coast of the Americas, North Atlantic; west coast of Africa to Cape of Good Hope; Mediterranean; Black Sea; Red Sea; Northwestern coast of U.S. from Washington to San Francisco; Ecuador; Japan; Australia; Oligocene, U.S.S.R.

#### *Balanus maroccana* Broch, 1927:21

REFERENCES: Beach, 1972:5; Stubbings, 1967:266.

DISTRIBUTION: North Africa; 40-75m.

#### *Balanus oppidieboraci* Ross, 1964a:490

DISTRIBUTION: Miocene, Virginia.

#### *Balanus pallidus* Darwin, 1854b:240

SYNONYMY: Utinomi, 1967:206.

DIAGNOSIS: Stubbings, 1963b:15.

REFERENCES: Aurivillius 1898a:31; Barnes & Healy, 1969:51 (biometrical studies); Barnes & Klepal, 1971:83 (pedicel of penis); Bassindale, 1961:485; Broch, 1924b:202; 1927c:26; 1931:58; Darwin, 1854b:240 (as *B. amphitrite stutsburii* and *B. candidus* n. sp.); Davadie, 1963:44; Gauld, 1957:10; Gruvel, 1903b:137,143 (as *B. dybowskii*); 1905a:233,257; Harding, 1962:278,281; Henry, 1954:443; 1959:192 (= *B. subalbidus* Henry, 1973); Karande, 1967:1247 (as *B. a. insignis*); Krüger, 1914:437; 1927b:13; LaCombe & Monteiro, 1974:633; Menesini, 1965:104 (as *B. pallidus stutsburii*); Moroni-Ruggieri, 1950:72; Nilsson-Cantell, 1925:28 (as *venustus*); 1931a:124; 1938a:179; 1938b:38,41 (as *B. a. insignis* n. sp.); Sandison, 1962:517 (populations on Guinea coast); 1966:363 (effect of salinity fluctuations); 1967:161 (naupliar stages); Sandison & Hill, 1966:235 (distribution in relation to salinity); Stubbings, 1959:1282 (abnormal development); 1961b:24; 1964b:338; 1965:887; 1967:277; Weltner, 1897:256; 1922:83; Zevina & Litvinova, 1970:173; Zullo, 1963b:9.

DISTRIBUTION: West coast of Africa; Northern Indian

Ocean; Gulf of Siam, southwestern Australia; Gulf of Mexico, Caribbean; Argentina (Patagonia). Pliocene. Italy.

#### *Balanus patellaris* (Spengler), 1780:101

SYNONYMY: Utinomi, 1968b:174.

DIAGNOSIS: Nilsson-Cantell, 1929a:4.

REFERENCES: Annandale, 1907:40; Caillaud, 1865:38; Caziot, 1921:52; Darwin, 1854b:259; Gruvel, 1903b:139; 1905a:238; Hoek, 1913:152,158; Nilsson-Cantell, 1921:328; 1938b:46; Weltner, 1897:268.

DISTRIBUTION: India to Philippines.

#### *Balanus playagrandensis* Weisbord, 1966:29

DISTRIBUTION: Pliocene, Venezuela.

#### *Balanus poecilotheca* Krüger, 1911a:48

SYNONYMY: Utinomi, 1958a:294.

DIAGNOSIS: Hiro, 1937c:435.

REFERENCES: Barnard, 1924:71; Broch, 1931:59 (as *B. amphitrite* forma *poecilosculpta*); Hiro, 1938a:303; 1939e:263; Krüger, 1911b:460; Nilsson-Cantell, 1934a:61; Pilsbry, 1916:110; Tarasov & Zevina, 1957:188; Utinomi, 1949a:22; 1962:216.

DISTRIBUTION: Japan; Formosa; Sulu Arch.: South Africa.

#### *Balanus reticulatus* Utinomi, 1967:216

SYNONYMY/DIAGNOSIS: Southward, 1975:11.

REFERENCES: Broch, 1922:314; 1931:58 (as *B. a. communis*); Darwin, 1854b:240 (as *B. a. communis*, in part); Henry, 1973:968; Hiro, 1938a:301 (as *B. a. communis*); Hoek, 1913:168 (as *B. a. communis*); Kolosváry, 1939b:129 (as *B. a. communis*); 1962b:205 (fossil); Mawatari, 1967:99 (as *B. a. tesselatus*); Rosell, 1973b:79 (as *B. a. amphitrite*); Southward & Crisp, 1963:43 (as *B. a. amphitrite* var.); Stubbings, 1961a:173; Utinomi, 1960:44; 1969b:51,52; 1970:356; Utinomi & Kikuchi, 1966:5 (as *B. variegatus tessalatus* nom. nov.).

DISTRIBUTION: Circumtropical fouling form.

#### *Balanus salaami* Nilsson-Cantell, 1932c:5

DISTRIBUTION: Dar-es-Salaam.

#### *Balanus subalbidus* Henry, 1973:968

DISTRIBUTION: Southeast U.S.; Gulf of Mexico and West Indies; generally in brackish water.

#### *Balanus suturaltus* Henry, 1973:983

DISTRIBUTION: West coast of Central America.

#### *Balanus uliginosus* Utinomi, 1967:202

SYNONYMY/DIAGNOSIS: Utinomi, 1957c:202.

REFERENCES: Hiro, 1938a:305; 1939e:263; Krüger, 1911a:51 (as *Balanus amphitrite niveus*); Mawatari, 1967:99 (distribution of fouling organisms); Mawatari et al., 1962:93; 1968:24 (propagation by ships); Rosell, 1973b:86 (as *B. a. krugeri*); Tarasov & Zevina, 1957:190; Utinomi 1949a:22; 1962:216; 1967:202 (new name for *B. a. krugeri* Nilsson-Cantell, 1932a:24); 1969b:52; 1970:356; Utinomi & Kikuchi, 1966:5; Zevina & Tarasov, 1963:93.

DISTRIBUTION: Southern Japan; southern Korea; China; Formosa.

#### *Balanus variegatus variegatus* Darwin, 1854b:241

SYNONYMY: Utinomi, 1968b:171 (includes *Balanus amphitrite malayensis* Hoek, 1913:172).

DIAGNOSIS: Harding, 1962:291.

REFERENCES: Bhatt & Bal, 1960:439; Broch, 1916:5; 1931:58; Daniel, 1955a:97 (gregariousness); 1955c:19; 1956:21 (influence of color); 1957a:305 (effect of illumination); 1957b:866 (influence of tide); Darwin, 1854b:241 (as *Balanus amphitrite* var. 8, *variegatus*); Foster, 1974:48 (as *B. amphitrite malayensis*); Gruvel, 1905a:233; 1907d:6; Hoek, 1913:172; Hutton, 1879:328; Karande, 1967:1245; 1974:229 (larval comparison with *B. amphitrite*); Karande & Palekar, 1966:143; Moore, 1944:333; Nilsson-Cantell, 1934a:60; 1934b:57; 1938b:39; Pope, 1945:362 (as *Balanus amphitrite cirratus*); Stubbings, 1963a:329; Tarasov & Zevina, 1957:183; Weltner, 1897:266; 1900:305.

DISTRIBUTION: New Zealand; Australia; Indonesia; Vietnam; Bay of Bengal.

#### *Balanus variegatus cirratus* Darwin, 1854b:241

SYNONYMY: Utinomi, 1967:214.

- DIAGNOSIS:** Harding, 1962:293.
- REFERENCES:** Darwin, 1854b:241 (as *Balanus amphitrite* var. 9 *cirratus*); Davadie, 1963:44; Gravel, 1903b:137; 1905a:234; Hiro, 1938b:302; 1939e:262; Kolosváry, 1961a:78; 1961c:150; 1962d:202; 1967b:392; Mawatari, 1967:99 (distribution of fouling organisms); Nilsson-Cantell, 1921:316; 1931a:111; 1932c:5; 1934a:61; 1934b:56; 1938b:40; Pope, 1945:362; Rosell, 1973:91; Skerman, 1960:610; Stubbings, 1963a:331; Tarasov & Zevina, 1957:182, 184 (as ? *B. amphitrite vladivostokensis*); Utinomi, 1949a:22; 1962:216; 1970a:357; Utinomi & Kikuchi, 1966:6; Weltner, 1897:266; Wisely & Blick, 1964:164 (*nauplius*); Zevina & Tarasov, 1963:89.
- DISTRIBUTION:** India; Indonesia; Australia; Philippines north to Korea. Miocene, U.S.S.R.
- Balanus venustus venustus* Darwin, 1854b:240
- SYNONYMY/DIAGNOSIS:** Stubbings, 1967:280.
- REFERENCES:** Annandale, 1906:138; Barnes & Klepal, 1971:81 (pedicel of penis); Broch, 1924b:202 et seq.; Daniel, 1955c:21; Darwin, 1854b:240 (as *B. amphitrite* var. 2, *venustus*); Gauld, 1957:10; Gravel, 1903b:137; 1905a:233; 1912a:346; Harding, 1962:283; Henry, 1973:976; Karande, 1967:1245; Karande & Palekar, 1966:145; Kolosváry, 1967b:392; Nilsson-Cantell, 1925:28; 1931a:110; 1938b:37; Stubbings, 1961b:29; 1961c:188; 1963b:21; 1964a:109; 1965:887; Tarasov & Zevina, 1957:189; Utinomi, 1960:46; 1969a:86; 1970:355; Weltner, 1897:265.
- DISTRIBUTION:** Mediterranean; west coast of Africa; South Africa; Persian Gulf; Bay of Bengal; Sea of Japan; 5-60m.
- Balanus venustus modestus* Darwin, 1854b:240
- SYNONYMY/DIAGNOSIS:** Harding, 1962:287.
- REFERENCES:** Darwin, 1854b:240 (as *B. amphitrite* var. 5, *modestus*); Gravel, 1905a:233; Weltner, 1897:266.
- DISTRIBUTION:** West Indies; Gulf Coast from Florida to Texas.
- Balanus venustus niveus* Darwin, 1854b:240
- SYNONYMY:** Zullo, 1966b:232.
- DIAGNOSIS:** Harding, 1962:286.
- REFERENCES:** Barnes & Klepal, 1971:81 (pedicel of penis); Bernard & Lane, 1961:438 (absorption, excretion); 1962:19 (early settlement and metamorphosis); Bousfield, 1954:122; Costlow & Bookhout, 1956:107; Darwin, 1854b:240 (as *B. amphitrite* var. 4, *niveus*); Dawson, 1957:1068 (fouling of shrimp); deOliveira, 1941:19 (= *B. citerosum* Henry, 1973, in part); Doochin, 1951:15 (attachment and metamorphosis); Driscoll, 1968:27; Eldred, 1962:203 (fouling of shrimp); Fowler, 1912:pl. 46; Gravel, 1903b:137; 1905a:224 (as *Balanus armatus*), 233; 1907d:6; 1909b:25; Henry, 1954:443 (distribution); 1959:193; Hiro, 1939e:263 (see *B. uliginosus*); Kolosváry, 1943a:84; 1961a:78; 1961c:150; 1962d:202; 1967b:312; Krüger, 1911a:51; 1911b:460; Lanchester, 1902:369; Matsui et al., 1964:144; McDougall, 1943:354; Müller, 1867:329 (as *Balanus armatus*); Nilsson-Cantell, 1921:318; 1925:31; 1928a:33; 1931a:111; 1938b:39; 1939a:4; 1957:10; Pearse, 1947:326 (on *Limulus*); Pilsbry, 1916:92; 1953:25; Ross, 1962:14; Smith, 1946:51 (effect of water currents); Stubbings, 1964b:340; 1967:268; Tarasov & Zevina, 1957:168; Utinomi, 1969a:87; Wells, 1966:85; Weltner, 1895:289 (as *Balanus armatus*); 1897:265, 267; 1922:83; Zevina & Litvinova, 1970:174; Zullo, 1963b:12.
- DISTRIBUTION:** Western Atlantic, Cape Cod to Brazil; Mediterranean; west and south Africa; Madagascar; Red Sea; Persian Gulf; to 55m. Miocene, U.S.S.R.; Plio-Pleistocene, Florida.
- Balanus venustus obscurus* Darwin, 1854b:241
- SYNONYMY/DIAGNOSIS:** Harding, 1962:289.
- REFERENCES:** Barnard, 1924:70; Darwin, 1854b:241 (as *B. amphitrite* var. 7, *obscurus*); Davadie, 1963:44; Gravel, 1905a:233; Lanchester, 1902:369; Wells, 1966:85; Weltner, 1897:266.
- DISTRIBUTION:** Caribbean; South Africa.
- Genus *Tetrabalanus* Cornwall, 1941**
- Tetrabalanus polygenus* Cornwall, 1941:228
- SYNONYMY/DIAGNOSIS:** Zullo, 1969d:2.
- REFERENCES:** Henry, 1973:983,992.
- DISTRIBUTION:** Ecuador; Costa Rica; prefers estuarine conditions.
- Group of *Balanus trigonus*
- Balanus alatus* Hoek, 1913:175
- REFERENCE:** Pilsbry, 1916:110.
- DISTRIBUTION:** Sulu Arch.; 50-564m.
- Balanus calidus* Pilsbry, 1916:118
- SYNONYMY:** Zullo, 1966b:235.
- DIAGNOSIS:** Pilsbry, 1916:118.
- REFERENCES:** Daniel, 1955c:21; Darwin, 1954b:225; DePalma, 1963:19 (fouling); Henry, 1954:443; Hulings, 1961:215; Karande, 1966:146; 1967:1245; Kolosváry, 1943a:87; 1962a:85; 1967b:391; Nilsson-Cantell, 1939a:6; Ross et al., 1964:312; Wells, 1966:83; Wells & Richards, 1962:586; Wells, Wells & Gray, 1964:561.
- DISTRIBUTION:** North Carolina; Gulf of Mexico; West Indies; 27-64m. Oligocene, Bulgaria. Pleistocene: northern Columbia and Cape Hatteras.
- Balanus calidus nonstriatus* Kolosváry, 1941a:41
- DISTRIBUTION:** Gulf of California.
- Balanus curvirostratus* Menesini, 1968c:619
- DISTRIBUTION:** Pliocene, Italy.
- Balanus darwini* Seguenza 1876:453
- REFERENCES:** Seguenza, 1876:455 (var. *calabrus*); Davadie, 1953:99; Davadie-Suaudeau, 1952:29; Withers, 1953:62.
- DISTRIBUTION:** Tertiary, Italy.
- Balanus kanakoffi* Zullo, 1969a:7
- DISTRIBUTION:** Pliocene, California.
- Balanus laevis* Brugière, 1789:164
- SYNONYMY:** Nilsson-Cantell, 1921:321.
- DIAGNOSIS:** Pilsbry, 1916:120.
- REFERENCES:** Barnes & Klepal, 1971:83 (pedicel of penis); Cailliaud, 1865:38; Darwin, 1854b:227; Davadie, 1963:36; Gravel, 1905a:228; Hoek, 1883:150; 1907:4; Kolosváry, 1941e:1 (as *B. laevis nonsulcatus* n. sp.); 1943a:87; 1955:184; 1959:198; 1960:590; Miers, 1881:79; Newman & Ross, 1971:174; Nilsson-Cantell, 1930c:254; 1931a:112; 1939b:237; 1957:18; Ortmann, 1902:254 (probably includes *B. apertus* Philippi 1887:224); Weltner, 1895:291; 1897:263; 1898b:5; 1900:305; Zevina & Kurshakova, 1973:183.
- DISTRIBUTION:** Argentina to Tierra del Fuego; Falkland Islands to Peru; tidal to 275m. Miocene of Europe and North Africa; Pleistocene of South America.
- Balanus laevis coquimbensis* Sowerby (in Darwin), 1846:264
- SYNONYMY/DIAGNOSIS:** Pilsbry, 1916:122.
- REFERENCES:** Darwin, 1854b:227; 1897:623; Newman & Ross, 1971:175; Phillipi, 1887:224; Weltner, 1897:263.
- DISTRIBUTION:** Straits of Magellan to Coquimbo, Chile. Pleistocene, Coquimbo.
- Balanus laevis fossilis* Kolosváry, 1950b:3
- DISTRIBUTION:** Miocene, Hungary.
- Balanus laevis nitidus* Darwin, 1854b:227
- SYNONYMY/DIAGNOSIS:** Pilsbry, 1916:122.
- REFERENCES:** Davadie, 1963:37; Davadie-Suaudeau, 1952:26; Gravel, 1903b:136; 1905a:228; Kolosváry, 1940a:91; Newman & Ross, 1971:175; Nilsson-Cantell, 1957:19; Weltner, 1887:101.
- DISTRIBUTION:** Straits of Magellan to Callao, Peru. Miocene, Algeria.
- Balanus laguarensis* Weisbord, 1966:18
- DISTRIBUTION:** Pliocene, Venezuela.
- Balanus leonensis* Weisbord, 1966:43
- DISTRIBUTION:** Miocene, Florida.
- Balanus minutus* Hoek, 1913:177
- SYNONYMY/DIAGNOSIS:** Hoek, 1913:177.
- REFERENCES:** Broch, 1922:317; Nilsson-Cantell, 1925:31; Pilsbry, 1916:78; Utinomi, 1968b:173.
- DISTRIBUTION:** Sulu Is.; Bonin Is.; Singapore; 28-146m.

*Balanus ochlockoneensis* Weisbord, 1966:46

DISTRIBUTION: Miocene, Florida.

*Balanus parkeri* Zullo, 1967:c:1

DISTRIBUTION: Gulf of California; 25-36m.

*Balanus poecilus* Darwin, 1854b:246

SYNONYMY/DIAGNOSIS: Henry, 1960:142.

REFERENCES: Gravel, 1905a:229; Nilsson-Cantell, 1957:3;

Pilsbry, 1916:110; Weltner, 1895:289; 1897:266; 1898b:9.

DISTRIBUTION: Gulf of California and western coast of South America.

*Balanus provisoricus* Kolosváry, 1961:101

DISTRIBUTION: Miocene, SSSR.

*Balanus spongicola* Brown, 1844:121

SYNONYMY/DIAGNOSIS: Stubblings, 1963b:22.

REFERENCES: Barnard, 1924:69; Broch, 1927c:23 (as *Balanus dollfusi* n. sp.); Crisp & Southward, 1961:271 (cirral activity); Darwin, 1854a:16; 1854b:225; Davadie, 1964:49; deAlessandri, 1895:275; 1906:290; 1907b:277; Gru, 1903b:136; 1905a:225; 1907b:164; 1909b:25; 1920.. Hoek, 1875:59; 1909:271; Kolosváry, 1943a:87; 1947a:65; 1951c:412; Krüger, 1940:464; Menesini, 1965:106; 1966:115; 1967b:220; 1972:40; Nilsson-Cantell, 1927a:784; 1938a:180; 1939c:93; O'Riordan, 1967:294; Pilsbry, 1916:115; Relini, 1969:171; Seguenza, 1876:288; Southward & Crisp, 1963:30; Stebbing, 1910:568; Stublings, 1961b:32; 1961c:188; 1964b:327 (as *B. dollfusi* Broch); Weltner, 1897:263; Withers, 1953:61; Zullo, 1966b:235.

DISTRIBUTION: Southwestern England; Portugal; Madeira; Azores; West and South Africa; Indian Ocean. Oligocene to Pleistocene, Mediterranean Basin; Pliocene, England.

*Balanus spongicola pliocenicus* Seguenza, 1876:443

DISTRIBUTION: Tertiary, Italy.

*Balanus trigonus* Darwin, 1854b:223

SYNONYMY/DIAGNOSIS: Pilsbry, 1916:111 (includes *B. armatus* Müller, 1868:393).

REFERENCES: Barnard, 1924:68; Barnes & Klepal, 1971:83 (pedicel of penis); Broch, 1922:320; 1924b:202; 1931:60; 1935:1; 1947:6; Chilton, 1920:53; Cornwall, 1928:11; 1958:81; Cornwall, in Steinbeck & Ricketts, 1941:431; 433; Davadie, 1963:58; Dawyddoff, 1952:128; Day & Morgans, 1956:303; deOliviera, 1941:15; Foster, 1967a:82; 1967b:33 (early stages); Freiberger & Cologer, 1966:881 (laboratory rearing); Gordon, 1970:86; Gruvel, 1903b:136; 1905a:223; 1907a:105; 1907b:164; 1909b:25; 1912a:345,350; Guiler, 1952:20; Henry, 1941:104; 1942:127; 1943:369; 1954:443; 1960:139; Hirano, 1953:139 (rearing and metamorphosis); Hirano & Okushi, 1952:639 (attachment and growth rates); Hiro, 1932a:551; 1937c:439; 1938b:473 (on *Macrocheira kaempferi*); 1939e:263; 1939f:210; Hoek, 1883:149; 1913:152; Hutton, 1879:330; Jennings, 1918:61; Kawahara, 1961:65; 1962:27; 1963a:391; 1965:319 (fouling); Kolosváry, 1941d:210; 1943a:86; 1947a:65; 1951c:411; 1955:184; 1959:197; 1963a:173; 1963b:175; 1967b:392; Krüger, 1911a:49; 1911b:460; 1940:468; Lacombe & Monteiro, 1974:633; Luckens, 1970c:510; Matsuda, 1973:41; Mawatari, 1967:99 (distribution of fouling organisms); Mawatari et al, 1962:93 (water conduit fouling); Millard, 1950:266; Moore & McPherson, 1963:418; Moore, 1944:333; Nilsson-Cantell, 1921:319; 1927a:784; 1928a:34; 1931a:111; 1938a:180; 1938b:13; 1939a:5; 1939c:93; 1957:10; Ortmann, 1902:252; Pilsbry, 1909:70; 1916:111; Pope, 1945:361; Relini, 1962:1; 1964:405; 1966:179; 1968a:219; 1968b:186; 1969:173; Relini & Giordano, 1969:251 (settlement); Resig, 1969:20; Ritz & Foster, 1968:551 (temperature responses); Ross, 1962:22; 1964a:490; 1964b:271; Ross et al, 1964:313; Sandison, 1954:81; Skerman, 1960:610 (predation of); Stubblings, 1936:41; 1940:390; 1961b:31; 1963c:188; 1963b:21; 1964a:109; 1964b:341; 1965:890; 1967:267; Tarasov & Zevina, 1957:166; Utinomi, 1949a:22; 1950:63; 1958a:294; 1962:216; 1968b:173; 1969a:88; 1969b:52; 1970:357; Utinomi & Kikuchi, 1966:6; Weisbord, 1966:20 (cf. *trigonos*); Wells, 1966:83;

Wells et al, 1964:567; Weltner, 1897:262; 1900:307; 1922:85; Werner, 1967:64 (distribution and ecology); Wisely & Blick, 1964:164 (larvae); Withers, 1924:33; 1953:74 et seq.; Zevina & Litvinova, 1970:174; Zullo, 1963a:122 (*B. aethiops* Philippi, 1887:224 probably *B. trigonus*).

DISTRIBUTION: Cosmopolitan in warm seas; distribution for the most part natural. Miocene; Europe, Africa and North America; Pliocene, Italy and Red Sea; Pleistocene Hawaii.

#### Group of *Balanus perforatus*

*Balanus hystrix* Hoek, 1913:218

REFERENCE: Pilsbry, 1916:78.

DISTRIBUTION: Sunda I.; 40m.

*Balanus obliquus* Ross, 1964a:486

DISTRIBUTION: Miocene, Virginia.

*Balanus pacificus* Pilsbry, 1916:104 (= *Balanus concavus pacificus*)

SYNONYMY: Ross, 1962:16; 1964a:489.

DIAGNOSIS: Pilsbry, 1916:104.

REFERENCES: Boolootian, 1964:185 (on *Dendraster excentricus*); Cornwall, in Steinbeck & Ricketts, 1941:432; Cornwall, 1951:328; 1956:647; 1958:84; 1959:406; 1962:625; Darwin, 1854b:235 (in part, figs. 4a-c); Davadie, 1963:52; Giltay, 1934:1 (on *Dendraster*); Henry, 1942:104; 1943:367; 1959:200; 1960:146; Hertlein, 1934:61; Kolosváry, 1955:185; Merrill & Hobson, 1970:595 (on *Dendraster excentricus*); Nilsson-Cantell, 1957:6; Orcutt, 1921:24; Pilsbry, 1907d:199 (as *B. concavus* - recent, Point Loma); 1909:67 (as *B. concavus* - fossil, Peru); Weltner, 1895:291 and 1897:261 (as *Balanus tintinnabulum occator*); Zullo, 1969a:10.

DISTRIBUTION: South of San Francisco to Chile. Plio-Pleistocene of California; Pleistocene of Magdalena Is.; fossil, Peru.

*Balanus pacificus brevicalcar* Ross, 1964a:488

REFERENCE: Pilsbry, 1916:107,337 (as *Balanus concavus pacificus forma brevicalcar*); Ross, 1964a:488.

DISTRIBUTION: Newport, California.

*Balanus pacificus prebrevicalcar* Ross, 1964a:488

DISTRIBUTION: Miocene, Virginia.

*Balanus perforatus* Brugière, 1789:167

SYNONYMY/DIAGNOSIS: Pilsbry, 1916:123.

REFERENCES: Austin et al, 1958:497 (chromosome numbers); Barnes & Barnes, 1965a:391 (variation in egg and nauplius size); 1966a:83 (ecological and zoogeographical observations); 1968a:146 (variation in egg production); 1974:197 (embryonic development and salinity); Barnes & Crisp, 1956:636 (self-fertilization); Barnes & Klepal, 1971:83 (pedicel of penis); Barnes et al, 1970:70 (behavior on impact); 1971:173 (spermatozoa); 1972:191; Bassindale, 1964:37; Bishop et al, 1957:9; Bocquet-Védrine & Pochon-Masson, 1969:595 (spermiogenesis); Cailliaud, 1865:38; Caziot, 1921:52; Ciurea et al, 1933:7, 16; Crisp, 1964a:181, et seq. (effects of severe winter); Crisp & Patel, 1958:1078 (relationship between breeding and ecdysis); Crisp & Southward, 1961:271 (cirral activity); Daniel, 1955c:22; Darwin, 1954b:231; Davadie, 1963:38; Davadie-Suaudeau, 1952:20; deAlessandri, 1895:279; 1907b:278; Ephrusi, 1922:141 (spermatozoa); Fischer, 1872:432; Fischer-Piette & Prenant, 1956:16; Grasse & Tuzet, 1928:1543 (spermatozoa); 1932:9 (spermatozoa); Groom, 1894a:119 (early development); 1894b:81 (life history); Groom & Loeb, 1890:160 (naupliar behavior); Gruvel, 1905a:230; 1907d:6; 1912a:345; Hoek, 1909:271,283; 1913:158; Knight-Jones, 1953:585 (gregariousness); Kolosváry, 1943a:88; 1944:33; 1947a:14; 1947d:425; 1951b:292; 1951c:411; 1955:184; 1960a:591; 1963a:173,175; 1967b:392; Krüger, 1940:464; LeReste, 1965:64 (larva); Lochhead, 1936:429 (feeding mechanism of nauplius); Menesini, 1965:95; 1967b:217; Moore, 1936:703; Moyse, 1960:120; Munn & Barnes, 1970b:261 (fine structure of spermatozoa); Nilsson-Cantell, 1931a:112; Norris & Crisp, 1953:393 (distribution and planktonic

- stages); Norris et al, 1951:444 (variability in larval stages); O'Riordan, 1967:292; Patel & Crisp, 1960b:104 (rates of development of embryos); Prenant & Teissier, 1923:173; Pochon-Masson, et al 1969-1970:205; Relini, 1964:404; 1966:179 (fouling); 1968b:185; 1969:171; Relini & Giordano, 1969:251 (vertical distribution); Riedl, 1963: 258; Seguenza, 1876:293; Southward, 1955a:1124 (feeding); 1955b:403 (cirral activity and temperature); 1963: 798 (hemoglobin); Southward & Crisp, 1963:29; Stubbings, 1963b:30; 1964b:342; 1967:268; Tarasov & Zevina, 1957:193; Taylor, 1970:211 (frontolateral horns and glands); Weltner, 1898b:12; Withers, 1953:57 et seq.; Zevina, 1963:72.
- DISTRIBUTION: Great Britain; France; Spain; Mediterranean; Black Sea; northwestern coast of Africa. Oligocene-Pleistocene, Europe and Africa.
- Balanus perforatus altavellensis* Seguenza, 1876:446
- DISTRIBUTION: Tertiary, Italy.
- Balanus perforatus angustus* (Gmelin), 1789
- SYNONYMY: Darwin, 1845b:231.
- DIAGNOSIS: Davadie, 1963:39.
- REFERENCES: Broch, 1924b:204; 1927b:22; 1935:2; Gruvel, 1903b:136; 1905a:230; Kolosváry, 1942d:149; Nilsson-Cantell, 1931a:112; 1938a:180.
- DISTRIBUTION: Great Britain; France; Spain; Mediterranean coast of Africa; Indian Ocean.
- Balanus perforatus chordatus* Menesini, 1966:113
- DISTRIBUTION: Miocene, Italy.
- Balanus perforatus cranchii* (Leach), 1818:pl. 57
- SYNONYMY: Darwin, 1854b:231.
- DIAGNOSIS: Davadie, 1963:39.
- REFERENCES: Brown, 1844:121; Gruvel, 1905a:230; Menesini, 1965:101; Pilsbry, 1916:125; Weltner, 1897:264.
- DISTRIBUTION: Pleistocene, Italy.
- Balanus perforatus fistulosus* (Poli), 1791:22
- SYNONYMY: Darwin, 1854b:231.
- DIAGNOSIS: Gruvel, 1905a:230.
- REFERENCES: Broch, 1927c:23; Nilsson-Cantell, 1931a:112; Vivi, 1938:111 (digestive tract); Weltner, 1897:264.
- DISTRIBUTION: Denmark; Morocco; Canary Is.
- Balanus perforatus mirabilis* Darwin, 1854b:232
- SYNONYMY/DIAGNOSIS: Darwin, 1854b:231.
- REFERENCES: Gruvel, 1905a:230; Pilsbry, 1916:125; Weltner, 1897:254.
- DISTRIBUTION: Rochelle, France.
- Genus *Megabalanus* Hoek, 1913
- Megabalanus ajax* (Darwin), 1854b:214
- SYNONYMY/DIAGNOSIS: Nilsson-Cantell, 1938b:34.
- REFERENCES: Fischer, 1884:357; Gruvel, 1903b:126; 1905a: 214; 1907b:164; 1909b:25; 1912a:350; Hoek, 1913:151; Kolosváry, 1956:189; 1959:197; Krüger, 1940:464; Pilsbry, 1916:74; Weltner, 1897:262.
- DISTRIBUTION: Indian Ocean; Philippines; Solomon Is.; New Caledonia; Japan. Miocene, Hungary.
- Megabalanus algicola* (Pilsbry), 1916:72
- SYNONYMY: Utinomi, 1968b:170.
- DIAGNOSIS: Pilsbry, 1916:72.
- REFERENCES: Barnard, 1924:67 (includes var. *costatus*); Barnes & Barnes, 1965a:391 (variation in egg and nauplius size); Barnes & Klepal, 1971:81 (pedicel of penis); Dakin et al, 1948:176; Kolosváry, 1941a:43 (as *B. algicola algicola*, S. Africa; as *B. algicola japonica*, n. subsp. Japan); 1943a:80; 1947c:424 (as *B. algicola forma typica*, Pacific; as *B. algicola forma novarae* n.f., Pacific); Krüger, 1940:466; Millard, 1950:266; Nilsson-Cantell, 1939b: 236; Ritz & Foster, 1968:553 (temperature response); Sandison, 1954:80 (nauplii).
- DISTRIBUTION: South Africa; found elsewhere on ships (Allen, 1953).
- Megabalanus antillensis* (Pilsbry), 1916:63
- SYNONYMY/DIAGNOSIS: Pilsbry, 1916:63.
- REFERENCES: DePalma, 1963:15 (fouling); de Oliveira, 1941:14; Krüger, 1940:471; Lacombe & Monteiro, 1974:
- 633; Nilsson-Cantell, 1928a:31; 1931a:109; 1939a:3; Pilsbry, 1927:38; 1953:24; Ross, 1968:18; Weisbord, 1966:13; Wells, Wells & Gray, 1964:567.
- DISTRIBUTION: North Carolina to Rio de Janeiro.
- Megabalanus azoricus* (Pilsbry), 1916:62
- REFERENCE: Stubnings, 1967:265.
- DISTRIBUTION: Azores.
- Megabalanus californicus* (Pilsbry), 1916:65
- SYNONYMY: Ross, 1962:10.
- DIAGNOSIS: Henry, 1942:118.
- REFERENCE: Aleem, 1957:51; Barnes & Klepal, 1971:79 (pedicel of penis); Boolootian, 1958:91; Broch, 1922:310; Bruff, 1946:234; Coe, 1932:63; Coe & Allen, 1937:126; Cornwall, 1951:324; 1959:405; Graham & Gay, 1945:382; Henry, 1943:367; 1960:138; Hewatt, 1946:194; Hughes, 1914:212; Johnson & Snook, 1927:264; Kanakoff & Emerson, 1959:20; Merrill & Hobson, 1970:613; Rasmussen in Shelford, 1935:306; Willett, 1937:383; Zullo, 1968:1.
- DISTRIBUTION: Monterey Bay to Cape San Lucas, Baja California; Guaymas, Mexico. Plio-Pleistocene of California and Baja California.
- Megabalanus campbelli* (Filhol), 1885:487
- SYNONYMY: Foster, 1967a:82.
- DIAGNOSIS: Broch, 1922:310.
- REFERENCES Chilton, 1909:607; Gruvel, 1903b:128; 1905a: 214; Krüger, 1940:464; Linzey, 1942b:3; Pilsbry, 1916: 54; Weltner, 1897:276; 1900:305; Withers, 1924:27.
- DISTRIBUTION: Campbell I.; Otago Peninsula, New Zealand.
- Megabalanus clippertonensis* (Zullo), 1969c:501
- DISTRIBUTION: Clipperton I.
- Megabalanus coccopoma* (Darwin), 1854b:196
- SYNONYMY: Ross, 1962:9.
- DIAGNOSIS: Henry, 1942:120.
- REFERENCES Broch, 1922:310; Davadie, 1963:26; Gruvel, 1903b:126; 1905a:212; Henry, 1941:102; 1973:983; Jordan & Hertlein, 1926:420; Kolosváry, 1943a:79; Krüger, 1940:472; Lacombe & Monteiro, 1974:633; Nilsson-Cantell, 1931a:109; Pilsbry, 1916:68; Weltner, 1897:260.
- DISTRIBUTION: Mazatlan, Mexico to Panama; Rio de Janeiro; Mauritius; China; New Caledonia. Pliocene, Baja California.
- Megabalanus concinnus* (Darwin), 1854b:196
- SYNONYMY/DIAGNOSIS: Pilsbry, 1916:69.
- REFERENCES Barnes & Klepal, 1971:81 (pedicel of penis); Broch, 1931:56; Foster, 1967a:81; Gruvel, 1903b:126; 1905a:213; Hiro, 1936a:60 (commensalism); Jennings, 1918:61; Kolosváry, 1943a:79; Moore, 1944:333; Nilsson-Cantell, 1957:7; Stubnings, 1967:265; Weltner, 1897:260.
- DISTRIBUTION: West coast of South America.
- Megabalanus costatus* (Hoek), 1913:165
- DISTRIBUTION: Hull of "Siboga."
- Megabalanus crispatus* (Schröter), Darwin, 1854b:195
- SYNONYMY/DIAGNOSIS: Pilsbry, 1916:60.
- REFERENCES: Barnes & Klepal, 1971:81 (pedicel of penis); Gruvel, 1903b:212; Stubnings, 1967:265; Weltner, 1897:261.
- DISTRIBUTION: La Rochelle, Senegal; East Indies; on ships.
- Megabalanus cylindricus* (Gmelin), 1780:3213
- SYNONYMY: Holthuis & Sivertsen, 1967:44 (includes *B. capensis* Ellis, 1758 and *B. maxillaris* Gronovius, 1763.).
- DIAGNOSIS: Darwin, 1854b:209.
- REFERENCES: Barnard, 1924:67; Davadie, 1963:33; Gruvel, 1903b:129; 1905a:218; Kolosváry, 1943a:90; 1943b:121; Krüger, 1940:466; Nilsson-Cantell, 1925:28; 1930c:254; 1939b:237; 1939c:93; Pilsbry, 1916:77; Ritz & Foster, 1968:533 (temperature response); Sandison, 1954:90 (nauplii); Stebbing, 1910:568; Stubnings, 1967:267; Weltner, 1887:101; 1897:261.
- DISTRIBUTION: South Africa.
- Megabalanus decorus* (Darwin), 1854b:212
- SYNONYMY/DIAGNOSIS: Newman & Ross, 1971:176.

- REFERENCES:** Barnes & Klepal, 1971:81 (pedicel of penis); Broch, 1931:57; Chilton, 1909:607; 1911:311; Cornwall, 1959:401 (as *Balanus concavus pacificus*); 1960:831; Filhol, 1885:486; Foster, 1967a:81; Hutton, 1879:328; Gruvel, 1903b:126; 1905a:214; Jennings, 1918:60; Kruger, 1940:464; Linzey, 1942a:279; 1942b:1 (appendages); Monod & Dollfus, 1932:71; Moore, 1944:333; Nilsson-Cantell, 1927a:784; Pilsbry, 1916:77; Skerman, 1958:224 (fouling); Weltner, 1897:261; 1899a:443; 1900:307; Withers, 1924:25.
- DISTRIBUTION:** New Zealand, including Kermadec Is., Chatham I., Auckland Is.; sublittoral to 51m. Miocene and Pliocene, New Zealand.
- Megabalanus dollfusii* (de Alessandri), 1907b:275  
**DISTRIBUTION:** Upper Miocene, France.
- Megabalanus dorbignii* (Chenu), 1843  
**SYNONYMY/DIAGNOSIS:** Darwin, 1854b:196.  
**REFERENCES:** Gruvel, 1903b:126; 1905a:213; Pilsbry, 1916:71; Weltner, 1897:261.  
**DISTRIBUTION:** On ship from Java.
- Megabalanus galapaganus* (Pilsbry), 1916:70  
**REFERENCE:** Hedgpeth, 1969:11 (as *B. tintinnabulum*).  
**DISTRIBUTION:** Galapagos Is.
- Megabalanus giganteum* (Kolosváry), 1949:190  
**DISTRIBUTION:** Miocene, Hungary.
- Megabalanus honti* (Kolosváry), 1950b:1  
**DISTRIBUTION:** Miocene, Hungary.
- Megabalanus hungaricus* (Kolosváry), 1941:282  
**DISTRIBUTION:** Miocene, Hungary.
- Megabalanus intermedius* (Darwin), 1854b:196  
**SYNONYMY/DIAGNOSIS:** Darwin, 1854b:196.  
**REFERENCES:** Gruvel, 1905a:213; Pilsbry, 1916:71; Weltner, 1897:261.  
**DISTRIBUTION:** ?Peru (Weltner).
- Megabalanus isolde* (Holthuis & Sivertsen), 1967:41  
**REFERENCE:** Nilsson-Cantell, 1939b:237 (as *B. maxillaris*).  
**DISTRIBUTION:** Tristan da Cunha.
- Megabalanus javanicus* (Withers), 1923:282  
**DISTRIBUTION:** Miocene, Java.
- Megabalanus krakatauensis* (Nilsson-Cantell), 1934b:53  
**REFERENCE:** Krüger, 1940:464.  
**DISTRIBUTION:** Krakatau, Sunda Strait.
- Megabalanus leganyii* (Kolosváry), 1950:2  
**DISTRIBUTION:** Miocene, Hungary.
- Megabalanus multiseptatus* (Ross), 1964a:485  
**DISTRIBUTION:** Miocene, Virginia.
- Megabalanus nigrescens* (Lamarck), 1818:391  
**SYNONYMY:** Darwin, 1854b:210.  
**DIAGNOSIS:** Pope, 1945:361.  
**REFERENCES:** Barnes & Klepal, 1971:84 (pedicel of penis); Cornwall, 1960:829; Dakin et al., 1948:176; Davadie, 1963:32; Endean et al., 1956:88 (ecology and distribution); Gruvel, 1903b:129; 1905a:218; Kolosváry, 1943a:81; Krüger, 1914:429; 1927a:13; 1940:464; Stubbings, 1967:266; Weltner, 1897:241; Womersley & Edmonds, 1958:232 (ecology).  
**DISTRIBUTION:** Australia; elsewhere on ships.
- Megabalanus occator* (Darwin), 1854b:196  
**SYNONYMY:** Hiro, 1939e:260.  
**DIAGNOSIS:** Kolosváry, 1950a:290.  
**REFERENCES:** Borradale, 1900:799; Foster, 1974:46; Gruvel, 1905a:213; Kolosváry, 1943a:78; Krüger, 1940:471; Nilsson-Cantell, 1938b:34; 1957:6; Nomura, 1938:87; Pilsbry, 1916:59; Utinomi, 1949a:25; 1954:22; Weltner, 1895:291; 1897:261; Zevina & Tarasov, 1963:88.  
**DISTRIBUTION:** Indian Ocean; Indonesia; Fiji; Philippines; Formosa; Bonin Is. Pliocene, Ryukyu Is.
- Megabalanus peninsularis* (Pilsbry), 1916:66  
**SYNONYMY/DIAGNOSIS:** Pilsbry, 1916:66.  
**REFERENCES:** Henry, 1941:102; 1942:127; 1943:367; 1960:146; Kolosváry, 1943a:78; Nilsson-Cantell, 1927a:783 (= *M. volcano*).  
**DISTRIBUTION:** Cape San Lucas, Baja California; Acapulco, Mexico.
- Megabalanus plicatus* (Hoek), 1913:165  
**DISTRIBUTION:** Hull of "Siboga."
- Megabalanus psittacus* (Molina), 1782  
**SYNONYMY/DIAGNOSIS:** Pilsbry, 1916:75.  
**REFERENCES:** Bahamonde, 1958:214; Chapman, 1914:53; 67; Darwin, 1854b:207; Gruvel, 1903b:129; 1904:103; 1905a:217; 1905b:328; 1906a:270; 1907d:1; Henry, 1960:138; Kolosváry, 1941a:41; 1942c:139; 1943a:80; 1943b:121; 1955:185; 1967b:393; Lacombe, 1970:164 (cement glands); Menesini, 1967a:47; Nilsson-Cantell, 1929b:489 (mouthparts); 1931a:109; 1957:7; Ortmann, 1902:249; Phillipi, 1887:223; Pilsbry, 1909:66; Tournouér, 1903:471; Vayssiere, 1905:161; Weltner, 1895:291; 1897:261; 1898b:5; 1900:305; Zevina & Kurshakova, 1973:183.
- DISTRIBUTION:** Chile and Peru; Juan Fernandez Is.; Straits of Magellan; Southern Argentina. Plio-Pleistocene, Chile.
- Megabalanus psittacus chilensis* (Menesini), 1967:47 (*nomen nudum*)
- Megabalanus rosa* (Pilsbry), 1916:61  
**SYNONYMY/DIAGNOSIS:** Yamaguchi, 1973:130.  
**REFERENCES:** Broch, 1931:56; Hirano, 1953:139 (rearing and metamorphosis); Hiro, 1932a:549; 1937c:431; 1939f:208; Kawahara (marine fouling communities), 1962:27; 1963a:395; 1965:319; Kolosváry, 1943a:79; Krüger, 1940:471; Mawatari, 1967:99 (distribution of fouling organisms); Mawatari et al., 1962:93 (fouling); 1963:101 (growth rate, fouling); Nilsson-Cantell, 1931a:109; 1932b:16; Tarasov & Zevina, 1957:164; Utinomi, 1949a:21; 1950:63; 1958a:294; 1962:215; 1969b:51; 1970:349; Utinomi & Kikuchi, 1966:5; Yamaguchi, 1971:124.  
**DISTRIBUTION:** Japan, Formosa. Pleistocene, Japan.
- Megabalanus seguenzai* (de Alessandri), 1895:277  
**DISTRIBUTION:** Pliocene, Italy.
- Megabalanus spinosus* (Gmelin), 1791:3213  
**SYNONYMY:** Stubbings, 1967:265.  
**DIAGNOSIS:** Stubbings, 1961c:184.  
**REFERENCES:** Darwin, 1854b:196; Gruvel, 1903b:126; 1905a:212; Kolosváry, 1943a:78; Lacombe & Monteiro, 1974:633; Nilsson-Cantell, 1931a:109; 1938b:13; Pilsbry, 1916:58; Weltner, 1897:260.
- DISTRIBUTION:** Islands in the South Atlantic: St. Helena, São Tome, Príncipe, Annobon; Rio de Janeiro.
- Megabalanus stultus* (Darwin), 1854b:216  
**SYNONYMY/DIAGNOSIS:** Ross, 1968:14.  
**REFERENCES:** Gruvel, 1905a:221; Henry, 1954:443; Kolosváry, 1966:69 (as *Balanus stultus forma morycowae*); 1967b:393; Nilsson-Cantell, 1929a:1; 1939a:3; Pilsbry, 1916:235; 1927:38 (as *Tetraclita radiata*); 1953:25; Weltner, 1897:262.  
**DISTRIBUTION:** Florida and Caribbean; on *Millipora*.
- Megabalanus tanagrae* (Pilsbry), 1928:311  
**REFERENCE:** Gordon, 1971:83.  
**DISTRIBUTION:** Hawaiian Is.
- Megabalanus tintinnabulum* (Linnaeus), 1758:668  
**SYNONYMY:** Darwin, 1854b:194 (includes pre-Darwin references).  
**DIAGNOSIS:** Pilsbry, 1916:55.  
**REFERENCES:** Annandale, 1906:147; 1911:1170 (growth rate); Barnard, 1924:66; Barnes & Klepal, 1971:79 (pedicel of penis); Boolootian, 1958:91 (attached to echinoid); Borradale, 1903:441; Brocchi, 1814:597; Broch, 1924b:203; 1927c:20; 1927d:133; 1931:56; Bruntz, 1902:987 (excretion); Cailiaud, 1865:36; Caziot, 1921:51; Chilton, 1911:132; Cole & Addison, 1931:72 (stimulation by alcohols); Cole, 1932b:143 (sensitivity of cirri); Daniel, 1952:261 (respiratory mechanism); 1955a:99 (gregarious attraction); 1955c:17; 1956:21 (influence of color on settlement); 1957a:305 (effect of illumination on settlement); Daniel, 1957b:866 (influence of stage of tide); Darwin, 1854a:13; Davadie, 1952:26; 1963:26; Dawyoff, 1952:128; de Alessandri, 1895:270; 1906:285; 1907b:270; de Oliveira, 1941:11; 1947:720; Foster, 1967a:81; Gauld, 1957:10; Gruvel, 1893a:405 (shell growth and structure);

1903b:125; 1905a:211; 1909b:25; 1912a:345,350; Gwilliam, 1965:244 (photoreceptor response); Hart, 1967:1 (chromosomes); Hiro, 1937b:51; 1939a:128; 1939e:258; Hoek, 1883:147; Karande, 1967:1245; Karande & Palekar, 1966:142; Kolosváry, 1943a:77; 1947a:12; 1947c:424; 1947d:425; 1951b:291; 1951c:411; 1959:197; 1960:590; 1961c:149; 1967b:393; Krüger, 1911a:47; 1911b:460; 1940:464; Lacombe, 1966:1 (cement glands); 1967:1; 1968:1; Lacombe & Ligouri, 1969:170; Lacombe & Monteiro, 1974:633; Menesini, 1966:104; Moore, 1944:333; Mørch, 1852:67; Nilsson-Cantell, 1931a:119; 1938a:179; 1938b:33; 1939c:92; 1957:10; O'Riordan, 1967:291; Rao & Ganapati, 1969:193; Relini, 1969:170; Riedl, 1963:258; Seguenza, 1876:438; Stubbings, 1910:567; Stubbings, 1936:40; 1961b:20; 1961c:183; 1963b:13; 1964a:108; 1964b:336; 1965:885; 1967:263; Tarasov & Zevina, 1957:163; Visscher, 1928b:193 (fouling); Withers, 1924:24; Weltner, 1887:101; 1895:291; 1897:260; 1898b:6; 1900:305; 1910:528; Zevina, 1963:72; Zevina & Tarasov, 1963:87.

**DISTRIBUTION:** Localities specifically for *Balanus tintinnabulum tintinnabulum* or *Balanus tintinnabulum communis*: Western coast of Africa from Mediterranean to Cape of Good Hope; Eastern Mediterranean; Madagascar, Arabian Sea; Bay of Bengal; Thailand; Formosa; Sagami Bay, Japan; New Zealand; Rio de Janeiro; Peru; Oligocene and Miocene of Europe; Plio-Pleistocene; Venezuela.

*Megabalanus transsylvanicus* (Kolosváry), 1950:3

**DISTRIBUTION:** Miocene, Hungary.

*Megabalanus transversostrigatus* (Beurlen), 1958:3

**REFERENCES:** Brito, 1972:2.

**DISTRIBUTION:** Pará, Brazil.

*Megabalanus tubulatus* (Withers), 1924:28

**DISTRIBUTION:** Pliocene, New Zealand (Withers, 1953:80).

*Megabalanus tulipiformis* (Ellis), 1758:851

**SYNONYMY:** Utinomi, 1959a:382.

**DIAGNOSIS:** Darwin, 1854b:204.

**REFERENCES:** Crisp & Southward, 1961:271 (cirral activity); Davadie, 1952:27; 1963:30; de Alessandri, 1895:272; 1906:287; Gauld, 1957:10; Gruvel, 1903b:128; 1905a:216; 1909b:25; 1912a:350; 1920:53; Hoek, 1875:59; Kolosváry, 1943a:81; 1951c:411; Krüger, 1940:464; Menesini, 1965:92; 1966:107; 1967b:218; Nilsson-Cantell, 1921:308; 1931a:108; Relini, 1969:169; Seguenza, 1876:283; Southward & Crisp, 1963:28; Stubbings, 1961b:21; 1961c:187; 1963b:14; 1964a:108; 1964b:337; 1965:886; Visscher, 1928b:193 (fouling); Withers, 1953:60,63.

**DISTRIBUTION:** Mediterranean; France; Spain; Portugal; Africa; Madeira, Canary and Cape Verde Is.; 25-250m. Miocene-Pleistocene, Europe and North Africa.

*Megabalanus tulipiformis arenarius* (Seguenza), 1876:439

**REFERENCE:** Davadie, 1963:30.

**DISTRIBUTION:** Tertiary, Mediterranean Basin.

*Megabalanus tulipiformis etruscus* (Menesini), 1966:109

**DISTRIBUTION:** Miocene, Italy.

*Megabalanus validus* (Darwin), 1854b:195

**SYNONYMY/DIAGNOSIS:** Hoek, 1913:164,166.

**REFERENCES:** Broch, 1931:56; Gruvel, 1903b:126; 1905a:212; Krüger, 1914:429; 1940:471; Nilsson-Cantell, 1938b:12; Weltner, 1897:260.

**DISTRIBUTION:** Hull of "Siboga"; southwest Australia; Taiwan.

*Megabalanus venezuelensis* (Weisbord), 1966:17

**DISTRIBUTION:** Pliocene, Venezuela.

*Megabalanus vesiculosus* (Darwin), 1854b:195

**REFERENCES:** Gruvel, 1905a:211; Weltner, 1897:260.

*Megabalanus vinaceus* (Darwin), 1854b:213

**SYNONYMY/DIAGNOSIS:** Darwin, 1854b:213.

**REFERENCES:** Gruvel, 1905a:215; Krüger, 1940:466; Nilsson-Cantell, 1957:3; Weltner, 1895:289; 1897:261; 1898b:9.

**DISTRIBUTION:** West coast of South America.

*Megabalanus volcano* (Pilsbry), 1916:60

**SYNONYMY/DIAGNOSIS:** Yamaguchi, 1973:133.

**REFERENCES:** Hiro, 1937c:430; 1938c:1848 (resistance to salinity and exposure); 1939:208; Krüger, 1940:471; Mawatari et al, 1962:93 (fouling); Nilsson-Cantell, 1927a:783 (as *Balanus tintinnabulum peninsularis*); 1938b:34; Tarasov & Zevina, 1957:165; Utinomi, 1949a:21; 1958a:293; 1958b:51; 1969b:51; 1970:350; Utinomi & Kikuchi, 1966:5.

**DISTRIBUTION:** Southern Japan; Okinawa.

*Megabalanus wilsoni* (Zullo), 1969a:10

**DISTRIBUTION:** Pliocene, California.

*Megabalanus zebra* (Darwin), 1854b:195

**SYNONYMY:** Stubbings, 1967:264.

**DIAGNOSIS:** Pilsbry, 1916:57.

**REFERENCES:** Barnard, 1924:66; Barnes & Klepal, 1971:81 (pedicel of penis); Davadie, 1963:26; Gruvel, 1903b:126; 1905a:212; 1909a:214; 1912a:350; Hiro, 1939e:259; Karande, 1967:1245; Karande & Palekar, 1966:143; Kolosváry, 1943a:78; Menesini, 1966:106; Stubbings, 1961b:21; 1964a:108; Utinomi, 1968b:170; Weltner, 1897:260.

**DISTRIBUTION:** West Africa; Cape Verde Is. to Walvis Bay; Formosa; Philipines.

### Incertae Sedis

*Cthamalus revilei* Locard, 1878:17

**DISTRIBUTION:** Neogene, France

**REMARKS:** Absence of opercular parts, and size of shell (basal dia. 27mm, height 15mm) precludes assignment to *Cthamalus* ss.

*Balanus borsodensis* Kolosváry, 1952:410

**DISTRIBUTION:** Miocene, Hungary.

*Balanus chisletianus* Sowerby, 1859

**REFERENCE:** Withers, 1953:39.

**DISTRIBUTION:** Eocene(?), England.

*Balanus echinocola* Hoek, 1912:408

**DISTRIBUTION:** Malay Arch.; 216m.

**REMARKS:** Apparently never described, hence nomen nudum.

*Balanus ecuadoricus* Pilsbry & Olson, 1951:200

**DISTRIBUTION:** Oligocene of Ecuador.

**REMARKS:** Authors suggest relationship with *B. nubilus* but opercular parts appear close to *crenatus*.

*Balanus flosculoides* Kolosváry, 1941e:9

**DISTRIBUTION:** Japan.

*Balanus gizellae* Kolosváry, 1962c:195

**REFERENCE:** Kolosváry, 1967b:392.

**DISTRIBUTION:** Tonga I.

*Balanus hohmanni* Philippi, 1887:225

**DISTRIBUTION:** Tertiary, Chile.

*Balanus irregularis* Broch, 1931:61

**DISTRIBUTION:** Banda Sea; 290m.

**REMARKS:** Mouth parts wrong for *B. crenatus*; form is that of *Solidobalanus*, but Brock placed in his *Eubalanus* (porous wall), which for present precludes its assignment.

*Balanus humilis* Conrad, 1846:400

**REFERENCE:** Ross, 1967:173 (internal cast).

**DISTRIBUTION:** Miocene, Florida.

*Balanus mirabilis* Krüger, 1912:11

**REFERENCE:** Pilsbry, 1916:79.

**DISTRIBUTION:** Japan.

**REMARKS:** Figures suggest it may belong to the group of *B. amphitrite*.

*Balanus microstomus* Philippi, 1887:225

**DISTRIBUTION:** Tertiary, Chile.

*Balanus pannonicus* Kolosváry, 1952:233

**DISTRIBUTION:** Miocene, Hungary.

*Balanus sauntonensis* Parfitt, 1871:210

**DISTRIBUTION:** Fossil, North Devon, England.

*Balanus shilohensis* Pilsbry, 1930:431

**DISTRIBUTION:** Miocene, New Jersey.

**REMARKS:** Too incompletely known to be placed in a

- group. Pilsbry compares it to *B. concavus* and *Semibalanus*.  
*Balanus similis* Weltner, 1922:83  
DISTRIBUTION: Off South Africa; 638m.  
REMARKS: Porous wall precludes placing in *Solidobalanus*; figure suggests wall of 8 plates.  
*Balanus tuboperforatus* Kolosvary, 1962c:197  
REFERENCE: Kolosváry, 1967b:392.  
DISTRIBUTION: Tonga I.  
*Balanus tumorifer* Kolosváry, 1962c:195  
REFERENCE: Kolosváry, 1967b:392.

- DISTRIBUTION: Tonga I.  
*Balanus veneticensis* Seguenza, 1876:303  
REFERENCE: Withers, 1953:62.  
DISTRIBUTION: Tertiary, Italy.  
*Balanus violaceus* Gruvel, 1903b:133  
DISTRIBUTION: Unknown.  
REMARKS: Author compares with *nubilus*; appears to us to be closer to group of *B. amphitrite*. Lamy and André (1932:218, footnote) proposed specific name of *abeli* to replace *violaceus* which was preoccupied.

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<i>pannonicus</i>	69	<i>nippponensis</i>	46	<i>sinensis</i>	61,101
<i>pantanelli</i>	49	<i>purpurata</i>	54	<i>sinnurensis</i>	56,100
<i>parahesperius</i>	51	<i>Pycnolepas</i>	11	<i>sinuatus</i>	52
<i>parkeri</i>	66	<i>pygmaeus, -a</i>	55	<i>snelliusi</i>	57
<i>patellaris, Balanus</i>	64,100,101	<i>Pyrgoma</i>	58,55,57,59,23	<i>socialis</i>	51
<i>patellaris, Tetraclitæ</i>	48,100	<i>Pyrgomatidae, -inae</i>	58,11,13,23, 24,28,39,31	<i>solida, Chelonibia</i>	44
<i>patelliformis (see B. patellaris)</i>	101	<i>Pyrgomina</i>	59	<i>solidus, Solidobalanus</i>	51
<i>patula</i>	43,44,32,101,102	<i>Pyrgopsella</i>	58,23	<i>Solidobalanus</i>	50-51,69,70,23,30
<i>dentata</i>	44	<i>Pyrgopsis</i>	58	<i>S. (Bathybalanus)</i>	52,23,34
<i>pectinipes</i>	54	<i>quadrivittatus</i>	49	<i>S. (Hesperibalanus)</i>	51-52,23
<i>peninsularis</i>	68,69	<i>quadratoradiata</i>	59	<i>S. (Solidobalanus)</i>	50-51,23
<i>pentacrini</i>	52,34	<i>quarta</i>	59	<i>sookensis</i>	51
<i>perfecta, Tetraclitæ</i>	48	<i>quinquevittatus</i>	49	<i>sordidus</i>	52
<i>perforatus, Balanus</i>	66-67,100,101	<i>quintus</i>	57	<i>southwardi</i>	46,108
<i>altavellensis</i>	67	<i>radiata</i>	47,68	<i>spinifera, Acasta</i>	54
<i>angustus</i>	67	<i>wagneri</i>	47	<i>spiniferus, Balanus</i>	61
<i>chordatus</i>	67	<i>radicifer</i>	50	<i>spinitergum</i>	54
<i>cranchii</i>	67	<i>Radiolites</i>	61	<i>spinosa, Acasta</i>	54
<i>fistulosus</i>	67	<i>rafflesi</i>	63,101	<i>spinosus, Megabalanus</i>	68
<i>mirabilis</i>	67	<i>ramosa</i>	44	<i>spinulosa</i>	58,56,57,59,100
<i>perforatus, group of Balanus</i>	66-67,23	<i>rangi</i>	59	<i>spongicola</i>	66
<i>permitini</i>	42	<i>latum</i>	59	<i>pliocenicus</i>	66
<i>peruvianus</i>	63,101	<i>raphanoides</i>	61	<i>spongites</i>	54,100
<i>phineus</i>	51	<i>rariseptatus</i>	61	<i>sporillus</i>	54
<i>pictus</i>	62	<i>regalis</i>	61,101	<i>squamosa</i>	48,47,102
<i>pilsbryi, Euraphia</i>	41	<i>reginae</i>	45	<i>depressa</i>	48
<i>typica</i>	41	<i>renzi</i>	55	<i>formosana</i>	48
<i>neuseelandicus</i>	41	<i>reticulatus</i>	64,101,102	<i>japonica</i>	48
<i>pilsbryi, Catophragmus</i>	40	<i>revilei</i>	69	<i>milleporosa</i>	48
<i>pilsbryi, Tessarelasma</i>	46	<i>rhachianecti</i>	45	<i>panamensis</i>	48
<i>pilsbryi, Tetraclitella</i>	47	<i>rhizophorae</i>	41,40	<i>patellaris</i>	48,100
<i>Platylepas</i>	44,21	<i>roonwali</i>	53,100	<i>perfecta</i>	48
<i>Platylepadinae</i>	44-48,49,11,21	<i>rosa, Megabalanus</i>	68	<i>rubescens</i>	48
<i>playagrandensis</i>	64	<i>rosea, Chirona</i>	50	<i>elegans</i>	48
<i>plicatus, Actinobalanus</i>	49	<i>rosea, Tesseropora</i>	47,100	<i>rufotincta</i>	48,100
<i>plicatus, Epopella</i>	46	<i>rostratus</i>	61,100	<i>viridis</i>	48,100
<i>plicatus, Megabalanus</i>	68	<i>alaskensis</i>	61	<i>stalactifera</i>	48
<i>pioceneicus</i>	66	<i>apertus</i>	61	<i>confinis</i>	48
<i>poecilosculpta</i>	63,64,101	<i>heteropus</i>	61	<i>floridana</i>	48
<i>poecilotheca</i>	64,101	<i>dalli</i>	61	<i>milleporosa</i>	48
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<i>polygenus</i>	65	<i>rufotincta</i>	48,31,100	<i>stellula</i>	58
<i>Polylepas</i>	45	<i>rugosus</i>	46	<i>stellatus</i>	42,40,41,43,13,100,101,102
<i>polymerus</i>	40,31	<i>salaami</i>	64	<i>bisinatus</i>	43
		<i>saltonensis</i>	62,101	<i>cornutus</i>	43

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Figure 17. The remains of *Tetrachaelasma* sp., blanket the sea floor at a depth of nearly 2000m on the flanks of a seamount off Madagascar ( $26^{\circ}29'S$ ,  $46^{\circ}07'E$ ). The relatively primitive balanomorphoid *Tetrachaelasma southwardi* was first discovered by the R/V *Eltanin* in the Antarctic Basin, off southern Chile and off Cape Horn at comparable depths (Newman and Ross, 1971). It is the only balanomorphan known to occur in the abyss. The calcareous deposits depicted here, composed of more than 90% calcitic barnacle remains, including rostra up to 10 cm in length, represent the remains of animals that once lived on the seamount and were subsequently concentrated in the valleys and gorges around its flanks. Other accumulations of comparable barnacle content occur in the fossil record, but these developed *in situ* in shallow water. Photo courtesy of Robert L. Fisher, Scripps Institution of Oceanography.







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